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ABSTRACT

These teacher and student editions provide instructional materials for an introduction to surgical technology course. Introductory materials in the teacher edition include information on use, instructional/task analysis, academic and workplace skill classifications and definitions, related academic and workplace skill list, and crosswalk to Association of Surgical Technologists core curriculum objectives. Each module of instruction in the teacher edition includes some or all of these components: suggested activities, transparency masters, teacher supplements, written test and key, assignment sheets answers, optional assignment sheets and answers, and module review and answers. Each module in the student edition includes some or all of these components: learning activities sheet, module objective sheet, information sheet, student supplements, assignment sheets, and job sheets. Modules are designed for more than one lesson or class period of instruction. These four sections contain 17 modules as follows: orientation to surgical technology (professional responsibilities and relations, interpersonal relationships and communication skills, legal and ethical responsibilities); safety (environmental, work place); microbiology (introduction, infection and immunology, wound healing); pharmacology (basic math, weights and measures, syringes and hypodermic needles, pharmacologic agents, anesthesia); and biomedical science (computer skills, electricity, applied physics, robotics). (YLB)

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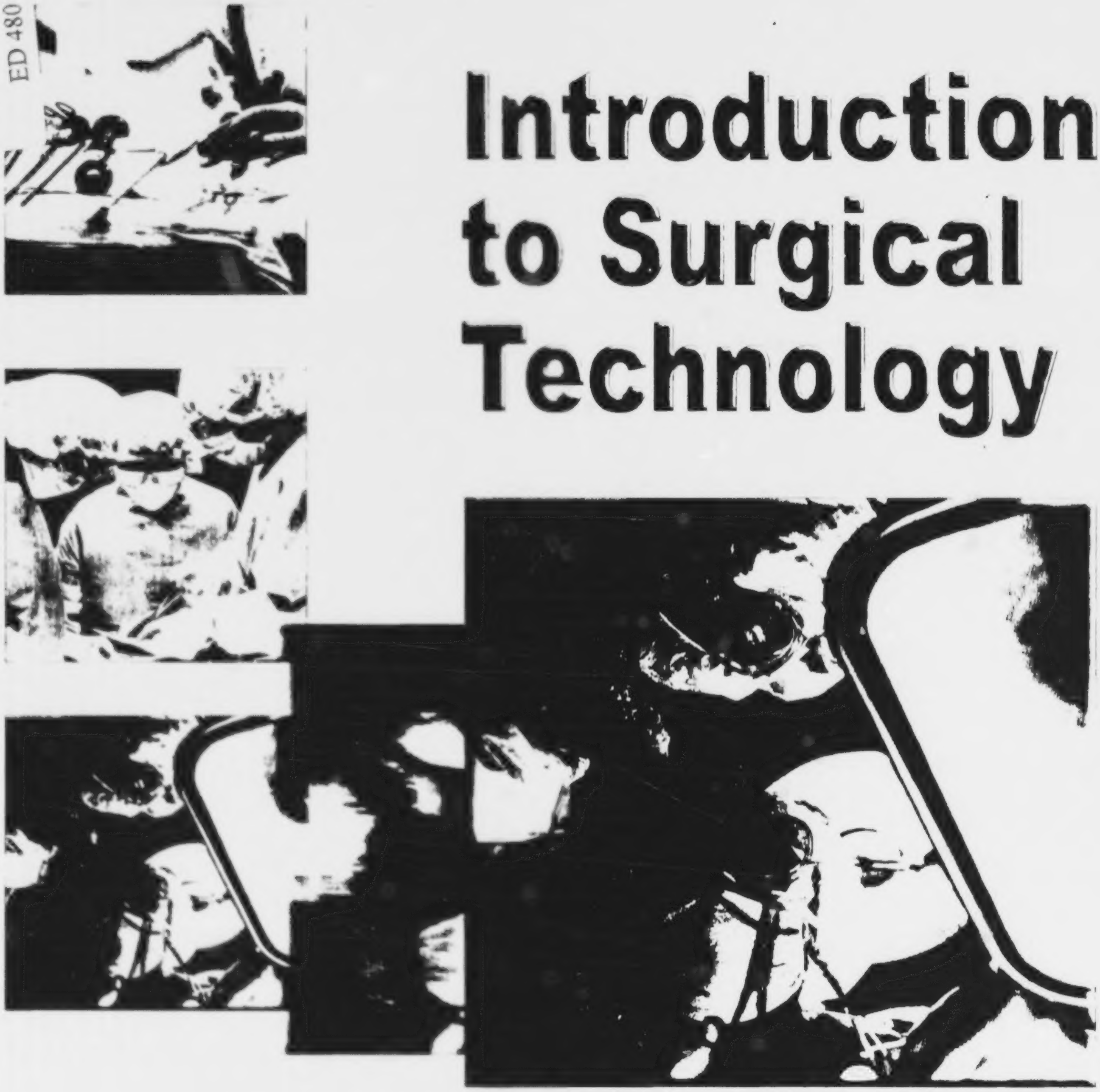
# Introduction to Surgical Technology



## Teacher Edition

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# Introduction to Surgical Technology

## Third Edition

## Teacher Edition

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# Introduction to Surgical Technology

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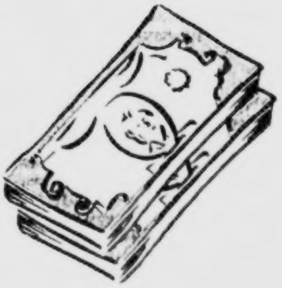

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# Use of Introductory Materials

Introductory materials are included in the teacher edition only and contain useful information to assist administrators and teachers in planning for instruction.

In addition to the general information—such as the table of contents and acknowledgments page—information is included on the following:

1. **Use of this publication**—Explains the components of a module of instruction and how they should be used as part of the teaching/learning process.
2. **Instructional/task analysis**—Provides a quick review of the contents of the publication; identifies cognitive (knowledge) skills addressed in each module of instruction.
3. **Academic and workplace skill classifications and definitions**—Defines the basic-skill classifications used by MAVCC. Skill areas reflected by skill groups, subskills, and descriptions have been identified using *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.
4. **Related academic and workplace skills list**—Classifies assignment and job sheets according to the related academic and workplace skills being reinforced.
5. **Crosswalk to AST Core Curriculum Objectives**—Indicates MAVCC module objectives identified in the Association of Surgical Technologists, Inc.'s, *Core Curriculum for Surgical Technology*, 5th ed., Englewood, Colorado, copyright 2002.

As you use these materials, it is hoped that they will provide useful information to meet a variety of needs.

# Use of This Publication

## Instructional modules

Each instructional module in a student edition includes some or all of the following components: learning activities sheet, module objective sheet, information sheet, student supplements, assignment sheets, and job sheets.

Each module in this teacher edition includes some or all of the following components for each of the modules of instruction: suggested activities, transparency masters, teacher supplements, written test, answers to written test, answers to assignment sheets, optional assignment sheets, answers to optional assignment sheets, module review, and answers to module review.

All of the module components focus on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Modules of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each module of instruction by the teacher will help to determine the following:

- Amount of materials that can be covered in each class period.
- Skills that must be demonstrated.
- Amount of class time needed for teacher demonstrations.
- Amount of time needed for student practice.
- Supplementary materials, including print and nonprint media and equipment and supplies, that must be ordered.
- Resource people who must be contracted.

## Student-edition components

It is a challenge to keep students motivated. Instructors should supplement the student-edition components by providing the "why," personal experiences, and current information. Prepare for each module by deciding how each component can best be taught. Allow students to become involved in preparing and planning their teaching/learning experiences.

**Learning activities sheet.** The learning activities sheet supplied in each module is a step-by-step instruction sheet instructors may use to guide each student's individual study through the required components in the student edition (module objective sheet, information sheet, student supplements, assignment sheets, and job sheets). The learning activities sheet also provides space for the instructor to include selected Web sites and optional assignments and activities, which allow the instructor to use his or her discretion in providing students with additional objectives in the same subject area as the required objectives provided in e student edition.

**Module objective sheet.** Each module of instruction is based on performance objectives that state the goals for successful completion of the course. These performance objectives are stated in two forms: module objectives, which state the expected performance of each student after completion of the module of instruction, and specific objectives, which state what the student must do to reach the module objective.

The objectives should be stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional module. The objectives can also help determine teaching strategies and instructional methods. Teachers should prepare for each module by deciding how each objective can best be taught.

Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the teacher should remember to supply the needed information-sheet, assignment-sheet, job-sheet, written-test, and module-review items.

**Information sheet.** The information sheet provides the content essential for meeting the cognitive (knowledge) objectives of the module. Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the module objective.

**Student supplements.** The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignments. Students are not directly tested over the information presented in a supplement; however, their ability to apply this information will be evaluated in the completion of an assignment sheet.

**Assignment sheet.** Assignment sheets provide students with pencil-and-paper activities that give students the opportunity to make practical application of the knowledge in the information sheet and student supplements. Criteria are provided to objectively evaluate student performance.

**Job sheet.** Job sheets are designed as skill tests and give the instructor direction as to the psychomotor skills to be taught, and provide the criteria to evaluate student performance objectively. They also help provide potential employers with a picture of the skills being taught during training and the performances that might be reasonably expected from an individual who has completed the training.

The teacher should discuss the equipment and materials that will be needed for the job and the criteria that will be used to evaluate the student's performance, and demonstrate the procedure prior to having students practice the procedure. Safety should be stressed as part of each demonstration.

When a student is ready to be evaluated, the teacher should follow the instructions for evaluating student performance which may be found in the suggested activities component of the teacher module.

### Teacher-edition components

**Suggested activities.** The suggested activities assist teachers during the preparation stage of the teaching/learning process by providing an instructional plan, teaching suggestions, and a list of supplemental resources. The teacher should read the suggested activities before teaching a module and decide how each objective can best be taught. Time should also be allowed to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the teacher will vary according to the particular module.

References used in the development of each module, suggested Web sites for student use, and supplemental resources are listed in the suggested activities. These materials can be used by the teacher to supplement her or his knowledge of the subject area or to help students with objectives in the area covered by a module of instruction.

**Transparency masters.** Transparency masters provide illustrations, charts, schematics, or additional information a teacher may use in group discussion to direct the students' attention to the topic of discussion.

**Written test.** This component is a criterion-referenced evaluation of the cognitive objectives presented in the information sheet. If the instructor has added, deleted, or modified objectives, appropriate changes should be made on the written test. It is recommended that the test be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered and before students attempt the assignment and job sheets presented in the student edition. The written test is included in the teacher edition only, but duplication is permitted for student use.

**Answers to written test.** Answers to written test are designed to assist the teacher in evaluating student performance on the written test.

**Answers to assignment sheets.** Assignment-sheet answers are designed to assist the teacher in evaluating student performance on the assignment sheets presented in the student edition.

**Optional assignment sheets.** When present in the teacher edition, these are optional assignments for the teacher to use to provide students with higher-level materials to stretch the advanced student or with remedial information or practice to assist the less-advanced student. These optional assignments may be duplicated for student use.

**Answers to optional assignment sheets.** These answers are designed to assist the teacher in evaluating student performance on the optional assignments presented in the teacher edition.

**Module review.** The module review is an objective test of the information presented in any of the components presented in the student edition. The objective questions are designed to test on many cognitive levels, and an attempt has been made to present some critical-thinking objective items in each module review. The module review is included in the teacher edition only, but duplication is permitted for student use.

A selection of test items from the modules covered may be used for a final test at the end of each term if desired. It is hoped that the objective format of the module reviews will help students prepare for the tests they must pass for certification in the various surgical-technology areas.

**Answers to module review.** These answers are designed to assist the teacher in evaluating student performance on the module review, which is presented in the teacher edition only.

# Instructional/Task Analysis

## Section A: Orientation to Surgical Technology

## Module 1-A: Professional Responsibilities and Relations

**Related information: What the student should know**

1. State the primary goal of surgical intervention.
2. Match reasons for surgical intervention to their correct descriptions.
3. List the three main types of hospitals and describe each.
4. List facilities where surgery can be performed.
5. Describe a typical hospital organizational chart.
6. Describe a typical hospital organizational structure for surgical services.
7. List hospital departments on which the surgical suite depends to give continuity of patient care.
8. List the members of the surgical team.
9. Distinguish between sterile and unsterile surgical team members.
10. Match surgical team members to their functions.
11. List areas of employment for the surgical technologist.
12. List ways of receiving training as a surgical technologist.
13. Define and state the purpose of a job description for a surgical technologist.
14. Select job responsibilities and functions of the scrub role.
15. Select job responsibilities and functions of the circulator.
16. List limitations of the surgical technologist.

**Application: What the student should be able to do**

17. Draw an organizational chart of the OR suite for a typical hospital. (Assignment Sheet 1)
18. Distinguish among duties of the surgical team members. (Assignment Sheet 2)
19. Research professional health care associations and their magazines/journals. (Assignment Sheet 3)
20. Research organizations that provide health care support. (Assignment Sheet 4)

## Module 2-A: Interpersonal Relationships and Communication Skills

**Related information: What the student should know**

1. Distinguish among types of relationships.
2. Select factors needed for good relationships.
3. Arrange in order Maslow's hierarchy of human needs.
4. List the causes of stress in the operating room, the impact of stress on the body, and methods of coping with stress.
5. Select true statements concerning psychosocial stress in the patient and within the surgical team.
6. List goals of communication.
7. Match means of communication to their correct descriptions.
8. State the purposes of communication among hospital team members.
9. List essential components of effective communication.
10. List effective listening skills utilizing components of communication.
11. Describe effective speaking skills.
12. Identify means of communication that enable other hospital departments to relate to the surgical suite and assure continuity of patient care and safety.
13. Select true statements concerning the importance of effective communication for the patient undergoing surgery.
14. Match techniques for therapeutic communication to their correct examples.
15. Match blocks to therapeutic communication to their correct examples.
16. Select communication requirements of the surgical team during surgery.

**Application: What the student should be able to do**

17. Evaluate your interpersonal relationship skills. (Assignment Sheet 1)
18. Evaluate your listening skills. (Assignment Sheet 2)
19. Apply effective communication skills in given situations. (Assignment Sheet 3)
20. Evaluate therapeutic communication skills in given situations. (Assignment Sheet 4)

## Module 3-A: Legal and Ethical Responsibilities

**Related information: What the student should know**

1. Discuss accountability for personal actions and obligations.
2. Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions.
3. List incidents that could result in litigation.
4. Define criteria used to establish negligence in court cases involving the surgical team.
5. Match terms related to credentialing to their correct definitions.
6. Discuss surgical conscience.
7. Complete statements concerning ethics.
8. List ways of making ethical decisions as a surgical technologist.
9. List resources that may help a surgical technologist interpret and follow professional standards of conduct.
10. List items in the surgical technologist's code of ethics.
11. Complete statements concerning standards of professional practice.
12. Select true statements concerning the Patient's Bill of Rights.

**Application: What the student should be able to do**

13. Evaluate legal cases involving surgery. (Assignment Sheet 1)
14. Evaluate ethical issues involving medicine. (Assignment Sheet 2)

## Module B: Safety

### Module 1-B: Environmental Safety

**Related information: What the student should know**

1. Discuss ways of developing a good safety attitude.
2. Complete statements concerning personal safety guidelines.
3. List general steps/guidelines for reporting defective equipment.
4. List expectations for a safe environment at school or work.
5. State the purposes of a material safety data sheet (MSDS).
6. Match MSDS sections to the information each section contains.
7. Match hazard placard and label symbols to their hazards.

8. Identify hazards using the NFPA 704 hazard triangle.
9. Match methods by which a hazardous material can enter the body to their correct descriptions.
10. Complete statements concerning the principles of body mechanics.
11. List basic types of emergencies.
12. Discuss severe weather safety guidelines.
13. Arrange in order the steps to follow on receiving a bomb threat.
14. Complete guidelines for general evacuation procedures in a fire emergency.
15. Describe the disabled person's fire evacuation responsibilities.
16. Identify the components of fire by labeling the sides of a fire tetrahedron.
17. Match fire classifications to their fuel sources.
18. Match fire extinguisher symbol shapes to fire classification letters.
19. Match extinguisher pictographs to the extinguisher's intended applications.
20. List the characteristics of fires appropriate for handling with a portable fire extinguisher.
21. Arrange in order the basic steps in using a fire extinguisher.
22. List fire prevention guidelines.
23. Complete statements concerning electrical safety.
24. Select true statements concerning basic equipment safety.

**Application: What the student should be able to do**

25. Subscribe to a safety pledge. (Assignment Sheet 1)
26. Complete an accident report form. (Assignment Sheet 2)
27. Interpret material safety data sheets. (Assignment Sheet 3)
28. Analyze severe weather scenarios. (Assignment Sheet 4)
29. Analyze fire emergency scenarios. (Assignment Sheet 5)
30. Apply safety principles to the school and workplace. (Assignment Sheet 6)
31. Use proper body mechanics in standing, sitting, moving, and lifting. (Job Sheet 1)
32. Operate a portable fire extinguisher. (Job Sheet 2)

## Module 2-B: Workplace Safety

**Related information: What the student should know**

1. Describe OSHA regulations required of employers.
2. Complete statements concerning OSHA and its role in workplace health and safety.
3. Complete statements concerning OSHA risk factors for violence to health care workers.
4. Name the four main components to any effective safety and health program that also apply to preventing workplace violence.
5. List responsibilities of management in creating an effective workplace violence prevention program.
6. List responsibilities of employees in creating an effective workplace violence prevention program.
7. Complete statements concerning OSHA-recommended engineering controls and workplace adaptation that can effectively prevent or control workplace violence hazards.
8. Complete statements concerning OSHA-recommended administrative and work practice controls to help prevent workplace violence.
9. List records that are important to the success of a workplace violence prevention program.
10. Select true statements concerning hazard communications.
11. Select true statements concerning information on a chemical label.
12. Complete basic health care workplace safety guidelines.
13. Match personal protective equipment (PPE) to their protective requirements.
14. Match major types of reactions to latex to their characteristics.
15. List ways of preventing latex allergy.
16. Complete statements concerning bloodborne pathogens.
17. Select true statements concerning the five different types of hepatitis.
18. Select true statements concerning bloodborne pathogens and their concern to operating room professionals.
19. Complete a chart comparing HIV and HBV.
20. List examples of devices that can cause sharps injuries.
21. List common causes of suture needle and scalpel injuries.
22. Complete guidelines for handling sharps and sharps boxes.
23. Match blunt needle categories to their selection guidelines.
24. Complete guidelines for safe blunt suturing techniques.

25. Explain the differences between Universal Precautions and Standard Precautions.
26. Complete statements concerning Standard Precautions.
27. Identify substances included in Standard Precautions that require hand protection (gloves).
28. List instances that require hand washing.
29. List CDC guidelines for proper hand washing.
30. Select true statements concerning guidelines for personal hygiene in the workplace.
31. Complete statements concerning the characteristics of radiation.
32. Match the three types of ionizing radiation to their characteristics.
33. Describe radiation safety practices.
34. State conditions that require immediate notification of the health care facility radiation safety officer.
35. Match compressed gases to their traditional U.S. cylinder colors.
36. List flammable anesthetic gases.
37. Select from a list common fire ignition sources in the operating room.
38. Match types of burns to their descriptions.
39. Discuss possible health-care related causes of patient thermal burns.
40. Select true statements concerning static electricity.
41. Complete statements concerning grounding operating room electrical equipment.
42. Discuss safeguards for preventing electrical and fire hazards in the operating room.
43. Match laser classes to their characteristics.
44. Distinguish between specular and diffuse laser beam reflections.
45. Match laser viewing hazards to their descriptions.
46. Complete statements concerning laser beam hazards to the eyes and skin.
47. Discuss precautions for using lasers safely.

**Application: What the student should be able to do**

48. Maneuver a wheelchair safely. (Job Sheet 1)
49. Maneuver a stretcher safely. (Job Sheet 2)
50. Demonstrate effective hand washing procedure. (Job Sheet 3)

## Module C: Microbiology

### Module 1-C: Introduction to Microbiology

**Related information: What the student should know**

1. Arrange in order the levels of the taxonomy system for classifying organisms.
2. Select major classes of microorganisms.
3. Describe the classes of microorganisms.
4. Match the types of microbial relationships to their correct descriptions.
5. Distinguish among normal flora, resident flora, and transient flora.
6. Describe the purpose of a gram stain.
7. Select true statements concerning characteristics of bacteria.
8. Label types of bacteria according to their shape.
9. Match specialized structures of bacteria to their correct descriptions.
10. Distinguish between types of toxins produced by bacteria.
11. Select true statements concerning growth requirements of bacteria.
12. Match pathogenic bacteria to the correct diseases they cause.
13. Distinguish between characteristics of fungi and algae.
14. Distinguish between characteristics of yeasts and molds.
15. Select true statements concerning characteristics of protozoa.
16. Match protozoan diseases to their correct causes and characteristics.
17. Complete statements concerning the characteristics of rickettsiae.
18. List diseases caused by rickettsiae.
19. Select true statements concerning characteristics of helminths.
20. List common parasites that afflict humans.
21. Complete statements concerning characteristics of viruses.
22. List viral diseases according to type.

**Application: What the student should be able to do**

23. Research the causes and prevention of a human disease. (Assignment Sheet 1)

## Module 2-C: Infection and Immunology

**Related information: What the student should know**

1. Define the term *infection.*
2. Select true statements concerning human portals of entry.
3. List human portals of exit.
4. Select factors influencing the occurrence of infection.
5. Match types of infections to their correct descriptions.
6. Match the stages of an acute infection to their correct descriptions.
7. Distinguish between direct and indirect contact in the transmission of pathogens.
8. Describe means of controlling the transmission of infections.
9. Complete statements concerning the effects of infection on a human host.
10. List factors that contribute to the spread of nosocomial infections.
11. Match organisms that cause common nosocomial infections to the infections they cause.
12. List the factors that influence the virulence of a pathogen in a host's body.
13. Complete statements concerning the body's defenses against diseases.
14. Select the correct purposes of inflammation.
15. List the symptoms of acute inflammatory response.
16. Select true statements concerning the treatment of acute inflammation.
17. Define the term *immunology.*
18. Distinguish between the types of immune responses.
19. Distinguish between a T cell and a B cell.
20. Match types of T cells and B cells to their correct functions.
21. Describe the types of cellular and tissue defense-mechanism processes the body uses against disease and infection.
22. Describe the phases of the antibody-production cycle that follows the body's exposure to an antigen.
23. Match types of white blood cells to their correct descriptions.
24. Select true statements concerning the types of immunity.
25. Match types of acquired immunity to their correct descriptions.

26. List types of vaccines.
27. Complete statements concerning the allergic response.
28. Complete statements concerning the characteristics of anaphylaxis.
29. Select true statements concerning the rejection syndrome.

**Application: What the student should be able to do**

30. Determine human portals of entry and exit for various diseases and infections. (Assignment Sheet 1)
31. Complete a personal immunity survey. (Assignment Sheet 2)
32. Practice critical thinking: complete a case study on immunity and infection. (Assignment Sheet 3)

## Module 3-C: Wound Healing

**Related information: What the student should know**

1. Match the types of injuries that can cause tissue damage to their correct description.
2. Distinguish among the basic types of wounds.
3. Distinguish among types of wound healing.
4. Complete statements concerning the phases of first intention wound healing.
5. Match classes of traumatic wounds to their correct descriptions.
6. Identify types of traumatic wounds.
7. Match classes of surgical (operative) wounds with their correct descriptions.
8. Select factors affecting the wound healing process.
9. Describe factors that present possible complications to the wound-healing process.
10. Complete statements concerning the effects of operative technique on wound healing.
11. Distinguish among types of wound disruption.
12. Complete statements concerning characteristics of wound disruption.

**Application: What the student should be able to do**

13. Classify surgical and traumatic wounds. (Assignment Sheet 1)
14. Determine types of traumatic wounds. (Assignment Sheet 2)
15. Distinguish between positive and negative effects on wound healing. (Assignment Sheet 3)

## Module D: Pharmacology

## Module 1-D: Basic Math

**Related information: What the student should know**

1. Match terms associated with math and measuring to their correct definitions.
2. Match symbols used in basic math with their names.
3. Label the place values of a whole number.
4. Add whole numbers to solve problems.
5. Subtract whole numbers to solve problems.
6. Multiply whole numbers to solve problems.
7. Divide whole numbers to solve problems.
8. Distinguish among types of fractions.
9. Reduce fractions to lowest terms.
10. Convert fractions and mixed numbers.
11. Add fractions to solve problems.
12. Subtract fractions to solve problems.
13. Multiply fractions to solve problems.
14. Label place values in a decimal number.
15. Add decimal numbers to solve problems.
16. Subtract decimal numbers to solve problems.
17. Multiply decimal numbers to solve problems.
18. Divide decimal numbers to solve problems.
19. Convert fractions and percentages.
20. Solve percentage problems.
21. Convert Roman numerals to Arabic numerals.

**Application: What the student should be able to do**

22. Add whole numbers. (Assignment Sheet 1)
23. Subtract whole numbers. (Assignment Sheet 2)
24. Multiply whole numbers. (Assignment Sheet 3)

25. Divide whole numbers. (Assignment Sheet 4)
26. Reduce fractions to lowest terms. (Assignment Sheet 5)
27. Convert fractions to mixed numbers. (Assignment Sheet 6)
28. Add fractions. (Assignment Sheet 7)
29. Subtract fractions. (Assignment Sheet 8)
30. Multiply fractions. (Assignment Sheet 9)
31. Add decimal numbers. (Assignment Sheet 10)
32. Subtract decimal numbers. (Assignment Sheet 11)
33. Multiply decimal numbers. (Assignment Sheet 12)
34. Divide decimal numbers. (Assignment Sheet 13)
35. Convert fractions and percentages. (Assignment Sheet 14)
36. Solve percentage problems. (Assignment Sheet 15)
37. Convert Roman numerals to Arabic numerals. (Assignment Sheet 16)
38. Read a U.S. customary rule. (Assignment Sheet 17)

## Module 2-D: Weights and Measures

**Related information: What the student should know**

1. Select true statements concerning the metric system of measurement.
2. Match metric prefixes with their correct amounts.
3. State metric equivalents of weight, capacity, and length.
4. List advantages of the metric system.
5. State abbreviations for metric weights and measures.
6. Distinguish between systems for measuring temperature.
7. Write the correct abbreviations pertaining to the handling of medications.

**Application: What the student should be able to do**

8. Solve problems concerning metric equivalents. (Assignment Sheet 1)
9. Use abbreviations for metric weight and measures. (Assignment Sheet 2)

## Module 3-D: Syringes and Hypodermic Needles

**Related information: What the student should know**

1. Discuss uses for syringes in the operating room.
2. Select the true statements concerning the characteristics of syringes.
3. Identify the parts of a syringe.
4. Complete statements concerning types of syringes used for irrigating.
5. Identify the types of syringes used for injecting and aspirating.
6. Distinguish between the types of syringe tips used for injecting and aspirating.
7. Select true statements concerning the characteristics of hypodermic needles.
8. Identify the parts of a hypodermic needle.
9. Complete statements concerning the care and handling of syringes and hypodermic needles.
10. Select true statements concerning the Occupational Safety and Health Administration (OSHA) regulations concerning the care and handling of sharps.

**Application: What the student should be able to do**

11. Read syringe calibrations. (Assignment Sheet 1)
12. Fill an irrigating syringe. (Job Sheet 1)
13. Draw up medication held by circulator. (Job Sheet 2)

## Module 4-D: Pharmacologic Agents

**Related information: What the student should know**

1. Define *pharmacology*, *pharmacodynamics*, and *pharmacokinetics*.
2. List purposes of drugs.
3. List the types of drug preparations with their correct descriptions.
4. List primary sources of drugs.
5. Distinguish among the types of names that a drug may have.
6. Select common sources of information concerning drugs.
7. Distinguish between the types of drug effects on the human body.
8. Complete statements concerning the route of administration of drugs.
9. Match classifications of common drugs used in surgery with their actions.

10. Select true statements concerning the characteristics of anticoagulants.
11. Complete statements concerning the characteristics of hemostatic agents.
12. Select true statements concerning the characteristics of antibiotic/anti-infectives commonly used in surgery.
13. Complete statements concerning narcotic analgesics.
14. Match drugs used for ophthalmic surgery with their correct uses.
15. Select true statements concerning characteristics of diuretics.
16. Select true statements concerning characteristics of steroids.
17. Complete statements concerning characteristics of hormones.
18. Complete statements concerning characteristics of contrast media.
19. Match common dyes used in surgery with their correct descriptions.
20. Complete statements concerning characteristics of intravenous solutions.
21. Complete statements concerning blood replacements, blood components, and blood substitutes.
22. Match miscellaneous drugs used in surgery for emergency situations with their correct descriptions.
23. Select true statements concerning the care and handling of medications.
24. Complete statements concerning the procedure for the surgical technologist to accept medication from the circulator.

**Application: What the student should be able to do**

25. Classify various drugs according to type. (Assignment Sheet 1)
26. Use a drug information reference. (Assignment Sheet 2)
27. Receive medication onto the sterile field. (Job Sheet 1)

## Module 5-D: Anesthesia

**Related information: What the student should know**

1. Complete statements concerning the ideal anesthetic agent used in anesthesiology.
2. Complete statements concerning the preanesthetic preparation of the patient.
3. Select purposes of preoperative medications.
4. Complete statements concerning the selection of preoperative medications.
5. Complete statements concerning classifications of premedications.
6. Select true statements concerning anesthesia.

7. Identify sites involved in the pathway of pain.
8. Distinguish among types of anesthetics.
9. Distinguish between methods of administering a general anesthetic.
10. List agents used for general anesthesia.
11. List the four phases of general anesthesia.
12. Match stages of general anesthesia with their correct descriptions.
13. Match types of local or regional anesthetics with their correct descriptions.
14. List agents used for local or regional anesthesia.
15. Match other anesthetic techniques occasionally used with their correct descriptions.
16. Complete statements concerning the characteristics of muscle relaxant drugs.
17. Distinguish between types of muscle relaxants.
18. List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia.
19. List narcotic antagonists used intraoperatively.
20. Discuss the care of the anesthetized patient.
21. Discuss circulator and scrub personnel roles during administration of anesthesia.
22. List possible complications of anesthesia.
23. Select true statements concerning malignant hyperpyrexia—malignant hyperthermia syndrome.
24. Complete statements concerning hemolytic reactions.
25. Complete statements concerning anaphylactic reactions.
26. Distinguish among actions of the surgical team if cardiac arrest occurs on the operating room table.
27. Match OR anesthesia equipment used for delivering anesthetics and/or monitoring the patient with their correct descriptions.
28. Match equipment used as adjuncts to anesthesia with their uses.
29. List types of thermoregulatory devices used in the operating room.
30. Complete statements concerning hemostasis and blood replacement.

## Module E: Biomedical Science

## Module 1-E: Computer Skills

**Related information: What the student should know**

1. List the uses of computers in the surgical suite.
2. Identify the basic components of a computer system.
3. Match types of input devices to their correct uses.
4. Complete statements concerning output devices.
5. Select true statements concerning computer memory.
6. Match computer storage devices to their correct descriptions.
7. Distinguish between basic computer operating systems.
8. Match terms related to the computer desktop to their correct descriptions.
9. List the characteristics of word-processing software.
10. Match basic word-processing software text-tool operations to their correct functions.
11. Match page-setup features to their correct descriptions.
12. Identify the primary functions of the icons located on a word-processing toolbar.
13. Match the primary functions on a word-processing toolbar to their icons.
14. Complete statements concerning the basics of using the Internet.
15. Select true statements concerning e-mail.

**Application: What the student should be able to do**

16. Examine computer operating manual(s) for basic operating procedures. (Assignment Sheet 1)
17. Examine word-processing software manual for basic operations. (Assignment Sheet 2)
18. Start/boot the computer. (Job Sheet 1)
19. Open and close a program. (Job Sheet 2)
20. Create a word-processed document. (Job Sheet 3)
21. Practice using the formatting toolbar. (Job Sheet 4)
22. Insert graphic and footnote/endnote in word-processed document. (Job Sheet 5)
23. Search the Internet. (Job Sheet 6)
24. Use e-mail. (Job Sheet 7)

## Module 2-E: Electricity

**Related information: What the student should know**

1. Define *electricity*.
2. Complete statements concerning the structure of matter.
3. Select true statements concerning the principles of electron flow.
4. Complete statements concerning the basic sources of electrical generation.
5. Select true statements concerning magnetism.
6. Complete statements concerning electromagnetism.
7. Match terms related to electrical current with their correct descriptions.
8. Select true statements concerning measuring electricity.
9. State Ohm's law.
10. State the formula for Ohm's law.
11. List the uses of Ohm's law.
12. Match the wires contained in an electrical receptacle with their correct descriptions.
13. Complete statements concerning wall outlets and plugs commonly used in the operating room.
14. List the primary equipment used in surgery that requires electricity to function.
15. List the major causes of electrical accidents.
16. Complete statements concerning facts about electrical shock.
17. Select true statements concerning static electricity.
18. Complete statements concerning grounding operating room electrical equipment.
19. Identify the components of an electrosurgery system.
20. Match electrosurgery components to their correct descriptions.
21. Distinguish between types of electrosurgery units.
22. Complete statements concerning safeguards for using electrosurgery units.

**Application: What the student should be able to do**

23. Evaluate surgical applications of electricity. (Assignment Sheet 1)
24. Position grounding pad and connect electrosurgical unit. (Job Sheet 1)

## Module 3-E: Applied Physics

**Related information: What the student should know**

1. Distinguish among gravitational, magnetic, and electrical forces.
2. Complete statements concerning pressure.
3. Match Newton's three laws of motion to their correct descriptions.
4. Explain why blood separates in a centrifuge.
5. Select true statements concerning types of simple machines.
6. Explain center of gravity and its effect on posture and occupational safety.
7. Complete statements concerning the modes of motion.
8. Select true statements concerning the composition of matter.
9. Select true statements concerning matter's three changes of state.
10. Complete statements concerning heat transfer.
11. Explain cryosurgery and its advantages.
12. Complete statements concerning waveforms.
13. Describe how ultrasound scans work.
14. Explain how doppler ultrasounds work.
15. Complete statements concerning the dual nature of light.
16. Match the electromagnetic spectrum types to their correct uses.
17. Complete statements concerning magnetism characteristics.
18. Distinguish between static and dynamic electricity.
19. Complete statements concerning electricity and electric current.
20. List the physical and biological effects of electric current that prove helpful in medicine.
21. Complete statements concerning fiber optics.
22. Describe how optical fiber is used in endoscopic surgeries.
23. Complete statements concerning the use of lasers in surgery.
24. Match laser types to their correct descriptions.
25. Select true statements concerning the use of nuclear medicine in surgery.
26. Complete statements concerning CT scans.

27. Explain the importance of setting irradiation and measuring dosage.

28. List methods for protecting against occupational irradiation.

**Application: What the student should be able to do**

29. Apply motion and leverage to the workplace. (Assignment Sheet 1)

30. Evaluate states of matter. (Assignment Sheet 2)

31. Apply electromagnetic waveforms to medicine. (Assignment Sheet 3)

32. Research lasers. (Assignment Sheet 4)

33. Visit a hospital to view radiation from preparation to disposal. (Assignment Sheet 5)

34. Recognize the implications of using nuclear medicine. (Assignment Sheet 6)

35. Test atmospheric pressure. (Job Sheet 1)

36. Create waveform polarization. (Job Sheet 2)

## Module 4-E: Robotics

**Related information: What the student should know**

1. Complete statements concerning the trend towards minimally invasive surgery.

2. List the four drawbacks of minimally invasive surgery.

3. Complete statements concerning surgical categories more easily adapted to MIS techniques.

4. List the fundamental impacts digital information has had on MIS technologies.

5. List the conditions which make the use of a robot instead of a human attractive.

6. Match the robotic characteristics that promote their use in surgical procedures to their correct descriptions.

7. Arrange in order the steps for integrating robotics into surgical procedures.

8. Describe the benefits of using robotics in MIS.

9. Identify the types of surgery where robotics can play a significant role.

10. List the pre-operative benefits of using robotics.

11. Complete statements concerning the inter-operative benefits of using robotics.

12. Select true statements concerning the post-operative benefits of using robotics.

13. Complete statements contrasting open incisions and MIS incisions.

14. Complete statements concerning key events in the invention of medical scope technology.

15. Match the two key scope types developed for endoscopic surgery since its advent in the late 1970's to their correct descriptions.

16. Select true statements concerning the difference in surgical stance when using flexible vs. rigid extenders.
17. List the primary issues in minimally invasive surgery.
18. Compare surgical technique in MIS with and without robotics.
19. Describe the four basic types of surgical robots.
20. Describe latency and its impact on telesurgery.
21. List the primary serial robotic components.
22. Identify each of the components in a telesurgical interaction.
23. Describe the functions of sensors and actuators.
24. Match sensor types to their correct descriptions.
25. Describe the function of the robotic components in the articulated mechanical system (AMS).
26. Match means of driving robotic arms to their correct descriptions.
27. Describe the sequence of events leading to robotic manipulation.
28. List the four basic types of movement.
29. Define *yaw*, *pitch*, and *roll*.
30. Match the degrees of freedom in the human arm to their correct motions.
31. Complete statements comparing degrees of freedom in a rigid endoscope and a flexible endoscope.
32. Complete statements concerning the degrees of freedom in the jointed medical robotic arm.
33. Complete statements concerning the four possible robotic control modes.
34. Identify components of robotic control.
35. List the options available for the user interface control and for monitoring surgical process.
36. List sensate options that should be available for an optimal haptics interface design.
37. Select true statements concerning the use of landmarks with robotics.
38. Identify each of the primary players during surgery.
39. List the four basic imaging tools used during an MIS procedure.
40. List the surgical tools potentially used during an MIS procedure.
41. Arrange in order the four basic preparatory steps for MIS or robotic procedures.
42. Arrange in order the steps to properly prepare and position robotic systems.
43. Complete statements concerning issues that must be addressed for integrating robotics into OR.

**Application: What the student should be able to do**

44. Evaluate MIS procedures. (Assignment Sheet 1)

45. Compare surgical robotics equipment. (Assignment Sheet 2)

46. Identify robotics components. (Assignment Sheet 3)

47. Identify robotic motion. (Assignment Sheet 4)

48. Explore clinical applications for robotics. (Assignment Sheet 5)

49. Demonstrate degrees of freedom in the human arm. (Job Sheet 1)

## Academic and Workplace Skill Classifications and Definitions

| Skill groups | Sub skills | Definitions |
|---|---|---|
| Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| | Science | Applying knowledge learned through study and practice that is based on scientific principles, methods, and techniques |
| | Listening | Receiving, interpreting, and responding to oral messages and other cues |
| | Speaking | Communicating a thought, idea, or fact verbally in a clear, concise manner |
| Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | Decision making | Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative |
| | Problem solving | Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results |
| | Seeing things in the mind's eye | Mentally organizing and processing symbols, pictures, graphs, and other information |
| | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Personal management skills | Responsibility | Exerting a high level of effort towards goal attainment, working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration |
| | Self-esteem | Developing self-confidence and maintaining a positive self-image |
| | Career awareness, development, and mobility | Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress |
| | Integrity/honesty | Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others |
| | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |
| Interpersonal skills | Teamwork | Working cooperatively with others to reach a common goal |
| | Coaching | Helping others learn new skills |

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## Academic and Workplace Skills Classifications and Definitions

| Skill groups | Sub skills | Definitions |
|---|---|---|
| Interpersonal skills (continued) | Leadership | Communicating ideas to justify position; accepting responsibility for others; and encouraging, persuading, convincing, or otherwise motivating an individual or group |
| | Negotiation | Resolving conflict between two or more individuals through discussion and compromise |
| | Customer service | Working and communicating with customers to satisfy their expectations |
| | Cultural diversity | Working well with men and women and with a variety of ethnic, social, or educational backgrounds |
| Information | Acquisition and evaluation | Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy |
| | Organization and storage | Organizing, processing, and maintaining written or computerized records and other forms of information in a systematic way |
| | Interpretation | Selecting and analyzing information and communicating the results to others |
| | Processing | Using computers to acquire, organize, analyze, and communicate information |
| Systems | Interrelationships | Knowing how social, organizational, and technological systems work and operate effectively |
| | Monitoring | Distinguishing trends, predicting impact of actions on system operations, diagnosing deviations in systems' performance, and correcting malfunctions |
| | Modification and design | Making suggestions to modify existing systems to improve products or services, and developing new or alternative systems |
| Technology | Selection | Choosing procedures, tools, or equipment including computers and related technologies |
| | Application | Demonstrating proper procedures for setting up and operating equipment |
| | Maintenance and troubleshooting | Preventing, identifying, or solving problems with equipment, including computers and other technologies |
| Resources | Time | Selecting relevant, goal-related activities; ranking them in order of importance; allocating time; and understanding, preparing, and following schedules |
| | Money | Using or preparing budgets, making forecasts, keeping records, and making adjustments to meet objectives |
| | Material and facilities | Acquiring, storing, and using materials and space efficiently |
| | Human resources | Assessing skills and distributing work accordingly, evaluating performance and providing feedback |

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# Related Academic and Workplace Skills List

## Section A: Orientation to Surgical Technology
## Module 1-A: Professional Responsibilities and Relations

| | | | |
|---|---|---|---|
| Draw an Organizational Chart of the OR Suite for a Typical Hospital (A.S. 1) | Thinking skills | Seeing things in the mind's eye | Mentally organizing and processing symbols, pictures, graphs, and other information |
| | Information | Interpretation | Selecting and analyzing information and communicating the results |
| | Systems | Interrelationships | Knowing how social, organizational, and technological systems work and operate effectively |
| Distinguish Among Duties of the Surgical Team Members (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| Research Professional Health Care Associations and Their Magazines/Journals (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| Research Organizations That Provide Health Care Support (A.S. 4) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |

## Module 2-A: Interpersonal Relationships and Communication Skills

| | | | |
|---|---|---|---|
| Evaluate Your Interpersonal Relationship Skills (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |

| | | | |
|---|---|---|---|
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Personal management skills | Career awareness, development, and mobility | Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress |
| Evaluate Your Listening Skills (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Personal management skills | Career awareness, development, and mobility | Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress |
| Apply Effective Communication Skills in Given Situations (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| Evaluate Therapeutic Communication Skills in Given Situations (A.S. 4) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | | Problem solving | Recognizing and defining problems |

## Module 3-A: Legal and Ethical Responsibilities

| | | | |
|---|---|---|---|
| Evaluate Legal Cases Involving Surgery (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Personal management skills | Integrity/honesty | Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others |

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| | | | |
|---|---|---|---|
| Evaluate Ethical Issues Involving Medicine (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Personal management skills | Integrity/honesty | Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others |

## Section B: Safety
## Module 1-B: Environmental Safety

| | | | |
|---|---|---|---|
| Subscribe to a Safety Pledge (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Personal management skills | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |
| Complete an Accident Report Form (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | | Problem solving | Recognizing and defining problems |
| Interpret Material Safety Data Sheets (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| Analyze Severe Weather Scenarios (A.S. 4) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | Personal management skills | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |

| | | | |
|---|---|---|---|
| Analyze Fire Emergency Scenarios (A.S. 5) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | Personal management skills | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |
| Apply Safety Principles to the School and Workplace (A.S. 6) | Basic skills | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | Personal management skills | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |
| Use Proper Body Mechanics in Standing, Sitting, Moving, and Lifting (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Resources | Material and facilities | Acquiring, storing, and using materials and space efficiently |
| Operate a Portable Fire Extinguisher (J.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |

## Module 2-B: Workplace Safety

| | | | |
|---|---|---|---|
| Maneuver a Wheelchair Safely (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| Maneuver a Stretcher Safely (J.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |

| | | | |
|---|---|---|---|
| Demonstrate Effective Hand Washing Procedure (J.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Personal management skills | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |

## Section C: Microbiology
## Module 1-C: Introduction to Microbiology

| | | | |
|---|---|---|---|
| Research the Causes and Prevention of a Human Disease (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |

## Module 2-C: Infection and Immunology

| | | | |
|---|---|---|---|
| Determine Human Portals of Entry and Exit for Various Diseases and Infections (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | Information | Interpretation | Selecting and analyzing information and communicating the results |
| Complete a Personal Immunity Survey (A.S. 2) | Personal management skills | Responsibility | Exerting a high level of effort towards goal attainment, working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration |
| | | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |
| Practice Critical Thinking: Complete a Case Study on Immunity and Infection (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |

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| | | | |
|---|---|---|---|
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |
| | | Processing | Using computers to acquire, organize, analyze, and communicate information |
| | Technology | Selection | Choosing procedures, tools, or equipment including computers and related technologies |

## Module 3-C: Wound Healing

| | | | |
|---|---|---|---|
| Classify Surgical and Traumatic Wounds (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Determine Types of Traumatic Wounds (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Distinguish Between Positive and Negative Effects on Wound Healing (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |

## Section D: Pharmacology
## Module 1-D: Basic Math

| | | | |
|---|---|---|---|
| Add Whole Numbers (A.S. 1) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Subtract Whole Numbers (A.S. 2) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Multiply Whole Numbers (A.S. 3) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |

| | | | |
|---|---|---|---|
| Divide Whole Numbers (A.S. 4) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Reduce Fractions to Lowest Terms (A.S. 5) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Convert Fractions to Mixed Numbers (A.S. 6) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Add Fractions (A.S. 7) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Subtract Fractions (A.S. 8) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Multiply Fractions (A.S. 9) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Add Decimal Numbers (A.S. 10) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Subtract Decimal Numbers (A.S. 11) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Multiply Decimal Numbers (A.S. 12) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Divide Decimal Numbers (A.S. 13) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Convert Fractions and Percentages (A.S. 14) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Solve Percentage Problems (A.S. 15) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Convert Roman Numerals to Arabic Numerals (A.S. 16) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Read a U.S. Customary Rule (A.S. 17) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |

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### Module 2-D: Weights and Measures

| | | | |
|---|---|---|---|
| Solve Problems Concerning Metric Equivalents (A.S. 1) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Use Abbreviations for Metric Weight and Measures (A.S. 2) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |

### Module 3-D: Syringes and Hypodermic Needles

| | | | |
|---|---|---|---|
| Read Syringe Calibrations (A.S. 1) | Basic skills | Arithmetic/mathematics | Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques |
| Fill an Irrigating Syringe (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Personal management skills | Organizational effectiveness | Adapting to the organization's goals, values, culture, and traditional modes of operation |
| Draw Up Medication Held by Circulator (J.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Interpersonal skills | Teamwork | Working cooperatively with others to reach a common goal |

### Module 4-D: Pharmacologic Agents

| | | | |
|---|---|---|---|
| Classify Various Drugs According to Type (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| Use a Drug Information Reference (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |
| Receive Medication Onto the Sterile Field (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Interpersonal skills | Teamwork | Working cooperatively with others to reach a common goal |

## Section E: Biomedical Science
## Module 1-E: Computer Skills

| | | | |
|---|---|---|---|
| Examine Computer Operating Manual(s) for Basic Operating Procedures (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| Examine Word-Processing Software Manual for Basic Operations (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| Start/Boot the Computer (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |
| Open and Close a Program (J.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |
| Create a Word-Processed Document (J.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |
| Practice Using the Formatting Toolbar (J.S. 4) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |
| Insert Graphic and Footnote/Endnote in Word-Processed Document (J.S. 5) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |
| Search the Internet (J.S. 6) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |
| Use E-Mail (J.S. 7) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |

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## Module 2-E: Electricity

| | | | |
|---|---|---|---|
| Evaluate Surgical Applications of Electricity (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Thinking skills | Problem solving | Recognizing and defining problems |
| Position Grounding Pad and Connect Electrosurgical Unit (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | Technology | Application | Demonstrating proper procedures for setting up and operating equipment |

## Module 3-E: Applied Physics

| | | | |
|---|---|---|---|
| Apply Motion and Leverage to the Workplace (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Evaluate States of Matter (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Apply Electromagnetic Waveforms to Medicine (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |

| | | | |
|---|---|---|---|
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Research Lasers (A.S. 4) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Listening | Receiving, interpreting, and responding to oral messages and other cues |
| | Thinking skills | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |
| | | Processing | Using computers to acquire, organize, analyze, and communicate information |
| Visit a Hospital to View Radiation From Preparation to Disposal (A.S. 5) | Basic skills | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |
| Recognize the Implications of Using Nuclear Medicine (A.S. 6) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Knowing how to learn | Using efficient learning techniques to acquire and apply new knowledge and skills |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Test Atmospheric Pressure (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |

| | | | |
|---|---|---|---|
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Create Waveform Polarization (J.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Interpersonal skills | Teamwork | Working cooperatively with others to reach a common goal |

## Module 4-E: Robotics

| | | | |
|---|---|---|---|
| Evaluate MIS Procedures (A.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |
| Compare Surgical Robotics Equipment (A.S. 2) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |

| | | | |
|---|---|---|---|
| | Technology | Selection | Choosing procedures, tools, or equipment including computers and related technologies |
| Identify Robotics Components (A.S. 3) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| Identify Robotic Motion (A.S. 4) | Basic skills | Science | Applying knowledge learned through study based on scientific principles |
| Explore Clinical Applications for Robotics (A.S. 5) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |
| | | Writing | Communicating a thought, idea, or fact in written form in a clear, concise manner |
| | | Science | Applying knowledge learned through study based on scientific principles |
| | Thinking skills | Creative thinking | Using imagination to generate new ideas |
| | | Decision making | Specifying goals and constraints, generating alternatives, considering risks and evaluating and choosing the best alternative |
| | | Problem solving | Recognizing and defining problems |
| | | Reasoning | Applying a rule or principle underlying the relationship between two or more objects when solving a problem |
| | Interpersonal skills | Leadership | Communicating ideas to justify position; accepting responsibility for others; and encouraging, persuading, convincing, or otherwise motivating an individual or group |
| | Information | Acquisition and evaluation | Obtaining data from existing sources and evaluating its accuracy |
| | | Interpretation | Selecting and analyzing information and communicating the results |

| | | | |
|---|---|---|---|
| Demonstrate Degrees of Freedom in the Human Arm (J.S. 1) | Basic skills | Reading | Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task |

## Crosswalk to AST Core Curriculum

This crosswalk aligns the MAVCC module objectives for *Introduction to Surgical Technology* to the content outlines in AST's *Core Curriculum for Surgical Technology*. If a blank appears under the "MAVCC Module Objectives" column, then the area is not covered in the MAVCC curriculum. The instructor should use supplemental resources to teach these areas.

| AST Course Outline | MAVCC Module Objective |
|---|---|
| **MICROBIOLOGY** | |
| **I. Introduction to microbiology**<br>**A. Historical background**<br>**B. Historical theories**<br>**C. Fields of study** | |
| **II. Introduction to the microscope**<br>**A. Microscope**<br>1. Parts of a microscope<br>2. Use of a microscope (in a lab setting) | |
| **III. Cell structure**<br>**A. Cells**<br>1. Cell theory<br>2. Basic characteristics<br>3. Cell classification<br>a. Prokaryotic<br>b. Eukaryotic | *Anatomy and Physiology*, Module Set I, Module 3-C: Objective 23—State the cell theory |
| **B. Cell structure — eukaryotic cells**<br>1. Nucleus<br>a. Nuclear membrane<br>b. Chromatin/chromosomes<br>2. Cell membrane<br>3. Cytoplasm<br>4. Nucleolus<br>5. Ribosomes<br>6. Endoplasmic reticulum<br>7. Mitochondria<br>8. Golgi apparatus<br>9. Lysosomes<br>10. Pinocytotic vesicles<br>11. Centrioles | *Anatomy and Physiology*, Module Set I, Module 3-C: Objective 26—Label the major parts of a cell; Objective 27—Match the major parts of a cell to their correct functions; Objective 28—Describe the major parts of a cell nucleus |
| 12. Microtubules/microfilaments<br>13. Cilia/flagella | *Anatomy and Physiology*, Module Set I, Module 3-C: Objective 29—Describe the specialized structures in cells; Objective 30—State the functions of the specialized structures in cells |

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|---|---|
| **C. Cell structure — prokaryotic cells**<br>1. Cell envelope<br>a. Capsule or slime layer<br>b. Cell wall<br>c. Cytoplasmic membrane<br>2. Mesosomes<br>a. Nucleoid<br>b. Plasmids<br>c. Ribosomes<br>d. Flagella<br>e. Pili/fimbriae | *Anatomy and Physiology*, Module Set I, Module 3-C: Objective 26—Label the major parts of a cell; Objective 27—Match the major parts of a cell to their correct functions |
| **IV. Fluid movement concepts**<br>A. Diffusion<br>B. Osmosis<br>C. Filtration<br>D. Active transport<br>E. Phagocytosis<br>F. Pinocytosis | *Anatomy and Physiology*, Module Set I, Module 3-C: Objective 35—Match types of active transport to their correct descriptions |
| **V. Microorganisms**<br>**A. Classification of organisms**<br>1. Kingdom<br>a. Plantae<br>b. Animalia<br>c. Fungi<br>d. Protists<br>e. Monera<br>2. Phylum<br>3. Class<br>4. Order<br>5. Family<br>6. Genus<br>7. Species | Module 1-C: Objective 1—Arrange in order the levels of the taxonomy system for classifying organisms |
| **B. Specific classes of microorganisms**<br>1. Algae<br>2. Protozoa<br>3. Fungi (yeasts and molds)<br>4. Bacteria<br>5. Rickettsiae<br>6. Viruses<br>7. Prions | Module 1-C: Objective 2—Select major classes of microorganisms; Objective 3—Describe the classes of microorganisms |
| **C. Characteristics of algae**<br>1. Morphology<br>2. Occurrence<br>3. Relationship to humans<br>4. Uses | Module 1-C: Objective 13—Distinguish between characteristics of fungi and algae |
| **D. Characteristics of protozoa**<br>1. Morphology<br>2. Nutrition<br>3. Classification according to locomotion<br>4. Pathogenicity<br>5. Occurrence in humans<br>6. Occurrence in nature | Module 1-C: Objective 15—Select true statements concerning characteristics of protozoa; Objective 16—Match protozoan diseases to their correct causes and characteristics |

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|---|---|
| **E. Characteristics of fungi (yeasts and molds)**<br>1. Morphology<br>2. Nutrition<br>3. Reproduction methods<br>4. Pathogenicity<br>5. Occurrence in humans<br>6. Occurrence in nature | Module 1-C: Objective 13—Distinguish between characteristics of fungi and algae; Objective 14—Distinguish between characteristics of yeasts and molds |
| **F. Characteristics of bacteria**<br>1. Morphology and grouping<br>2. Staining<br>3. Motility<br>4. Colonization<br>5. Nutrition<br>6. Biochemical activities<br>7. Pathogenicity<br>8. Occurrence in humans<br>9. Occurrence in nature | Module 1-C: Objective 7—Select true statements concerning characteristics of bacteria; Objective 8—Label types of bacteria according to their shape; Objective 9—Match specialized structures of bacteria to their correct descriptions; Objective 10—Distinguish between types of toxins produced by bacteria; Objective 11—Select true statements concerning growth requirements of bacteria; Objective 12—Match pathogenic bacteria to the correct diseases they cause |
| **G. Characteristics of rickettsiae**<br>1. Morphology<br>2. Staining<br>3. Transmission<br>4. Pathogenicity<br>5. Occurrence in humans<br>6. Occurrence in nature | Module 1-C: Objective 17—Complete statements concerning the characteristics of rickettsiae; Objective 18—List diseases caused by rickettsiae |
| **H. Characteristics of viruses**<br>1. Classification<br>2. Morphology<br>3. Differentiation from other cells<br>4. Lysogenic cycle<br>5. Bacteriophages<br>6. Genetic changes<br>7. Transmission<br>8. Pathogenicity<br>9. Occurrence in humans<br>10. Occurrence in nature | Module 1-C: Objective 21—Complete statements concerning characteristics of viruses; Objective 22—List viral diseases according to type |
| **I. Characteristics of prions**<br>1. Classification<br>2. Morphology<br>3. Pathogenicity<br>4. Occurrence in humans<br>5. Occurrence in nature | |
| **J. Common microbes and their diseases**<br>1. Staphylococcus aureus<br>2. Streptococcus pyogenes<br>3. Streptococcus pneumoniae<br>4. Neisseria gonorrhoeae<br>5. Emissaria meningitidis<br>6. Escherichia coli<br>7. Pseudomonas aeruginosa<br>8. Hemophilus influenzae<br>9. Mycobacterium tuberculosis | Module 1-C: Objective 12—Match pathogenic bacteria to the correct diseases they cause; Assignment Sheet 1—Research the causes and prevention of a human disease; Module 2-C: Objective 11—Match organisms that cause common nosocomial infections to the infections they cause; Assignment Sheet 1—Determine human portals of entry and exit for various diseases and infections |

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| **J. Common microbes and their diseases (cont.)**<br>10. Hemolytic streptococcus, alpha type<br>11. Nonhemolytic streptococcus<br>12. Clostridium perfringens<br>13. Clostridium tetani<br>14. Bacteroides species | Module 1-C: Objective 12—Match pathogenic bacteria to the correct diseases they cause; Module 1-C: Assignment Sheet 1—Research the causes and prevention of a human disease; Module 2-C: Objective 11—Match organisms that cause common nosocomial infections to the infections they cause; Assignment Sheet 1—Determine human portals of entry and exit for various diseases and infections |
| 15. Candida albicans | Module 1-C: Objective 14—Distinguish between characteristics of yeasts and molds |
| 16. Hepatitis A virus | Module 2-C: Teacher Supplement 2—Types of viral hepatitis |
| 17. Hepatitis B virus | Module 2-C: Objective 11—Match organisms that cause common nosocomial infections to the infections they cause |
| 18. Hepatitis C virus<br>19. Hepatitis D virus | Module 2-C: Teacher Supplement 2—Types of viral hepatitis |
| 20. Human Immunodeficiency Virus (HIV)<br>21. Prion disease | Module 2-C: Objective 11—Match organisms that cause common nosocomial infections to the infections they cause; Assignment Sheet 3—Practice critical thinking: complete a case study on immunity and infection |
| **VI. Immunologic defense mechanisms**<br>**A. Immunology** | |
| 1. Antigen | Module 2-C: Objective 9—Complete statements concerning the effects of infection on a human host |
| 2. Antibody/immunoglobulin | Module 2-C: Objective 22—Describe the phases of the antibody-production cycle that follows the body's exposure to an antigen |
| 3. Antigen-antibody reaction | Module 2-C: Objective 29—Select true statements concerning the rejection syndrome |
| **B. Immune response**<br>1. Lag phase<br>2. Primary response<br>3. Secondary response | Module 2-C: Objective 22—Describe the phases of the antibody-production cycle that follows the body's exposure to an antigen |
| **C. Acquired immunity**<br>1. Active<br>a. Natural<br>b. Artificial<br>2. Passive<br>a. Natural<br>b. Artificial | Module 2-C: Objective 24—Select true statements concerning the types of immunity; Objective 25—Match types of acquired immunity to their correct descriptions |

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| **D. Vaccines**<br>1. Nonpathogenic strains<br>2. Closely related microorganisms<br>3. Attenuated living pathogens<br>4. Killed pathogens<br>5. Extracts of pathogens<br>6. Toxoids<br>7. Recombinant DNA | Module 2-C: Objective 26—List types of vaccines |
| **VII. Hypersensitivity** | |
| **A. Immediate**<br>**B. Delayed**<br>**C. Autoimmunity**<br>**D. Terminology**<br>1. Allergen<br>2. Allergy<br>3. Localized allergic reaction<br>4. Anaphylactic shock | Module 2-C: Objective 27—Complete statements concerning the allergic response |
| **VIII. Process of infection** | |
| **A. Terminology**<br>1. Abscess | |
| 2. Acute infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions; Objective 6—Match the stages of an acute infection to their correct descriptions |
| 3. Aerobic<br>4. Anaerobic | Module 1-C: Objective 3—Describe the classes of microorganisms |
| 5. Antibiotic | |
| 6. Antibody | Module 2-C: Objective 13—Complete statements concerning the body's defenses against diseases |
| 7. Antigen | Module 2-C: Objective 9—Complete statements concerning the effects of infection on a human host |
| 8. Antisepsis<br>9. Antiseptic<br>10. Bacteremia<br>11. Bactericide<br>12. Bacteriostasis<br>13. Bioburden | |
| 14. Carrier | Module 2-C: Objective 3—List human portals of exit |
| 15. Chronic infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 16. Chronic/permanent<br>17. Community-acquired infection | |
| 18. Contaminated | Module 3-C: Objective 5—Match classes of traumatic wounds to their correct descriptions |

**A. Terminology (cont.)**

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|---|---|
| 19. Contamination | Module 2-C: Objective 8—Describe means of controlling the transmission of infections |
| 20. Convalescent carrier | |
| 21. Cross-contamination | |
| 22. Cross-infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 23. Culture | Module 1-C: Objective 6—Describe the purpose of a gram stain |
| 24. Disease | Module 2-C: Objective 1—Define the term infection |
| 25. Disinfectant | |
| 26. Disinfection | |
| 27. Droplet | Module 2-C: Objective 7—Distinguish between direct and indirect contact in the transmission of pathogens |
| 28. Endogenous source | |
| 29. Endotoxin | Module 1-C: Objective 10—Distinguish between types of toxins produced by bacteria |
| 30. Exogenous source | |
| 31. Exotoxin | Module 1-C: Objective 10—Distinguish between types of toxins produced by bacteria |
| 32. Facultative | Module 1-C: Objective 7—Select true statements concerning characteristics of bacteria |
| 33. Flora | Module 1-C: Objective 5—Distinguish among normal flora, resident flora, and transient flora |
| 34. Fomite | Module 2-C: Objective 7—Distinguish between direct and indirect contact in the transmission of pathogens |
| 35. Host | Module 2-C: Objective 1—Define the term infection |
| 36. Infection | |
| 37. Infectious agent | |
| 38. Inflammation | Module 2-C: Objective 13—Complete statements concerning the body's defenses against diseases |
| 39. Local infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 40. Necrotic | Module 3-C: Objective 10—Complete statements concerning the effects of operative technique on wound healing |
| 41. Nonsterile | |

**A. Terminology (cont.)**

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| 42. Nosocomial infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 43. Obligatory | |
| 44. Parasite | Module 1-C: Objective 3—Describe the classes of microorganisms |
| 45. Pathogens | Module 2-C: Objective 6—Match the stages of an acute infection to their correct descriptions |
| 46. Phagocytosis | Module 1-C: Objective 9—Match specialized structures of bacteria to their correct descriptions; Module 2-C: Objective 13—Complete statements concerning the body's defenses against diseases |
| 47. Primary infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 48. Principles of asepsis | |
| 49. Pus | Module 3-C: Objective 9—Describe factors that present possible complications to the wound-healing process |
| 50. Reservoir | |
| 51. Resident microorganism | Module 1-C: Objective 5—Distinguish among normal flora, resident flora, and transient flora |
| 52. Saprophyte | Module 1-C: Objective 13—Distinguish between characteristics of fungi and algae |
| 53. Secondary infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 54. Sepsis | |
| 55. Septicemia<br>56. Septicemia | Module 1-C: Objective 12—Match pathogenic bacteria to the correct diseases they cause |
| 57. Source | Module 1-C: Objective 13—Distinguish between characteristics of fungi and algae |
| 58. Spore | Module 1-C: Objective 9—Match specialized structures of bacteria to their correct descriptions |
| 59. Sterile<br>60. Sterile field<br>61. Sterile technique | |
| 62. Sterilization | Module 2-C: Objective 8—Describe means of controlling the transmission of infections |

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| **A. Terminology (cont.)**<br>63. Sterilizer<br>64. Superinfection<br>65. Suppuration<br>66. Surgically clean | |
| 67. Systemic infection | Module 2-C: Objective 5—Match types of infections to their correct descriptions |
| 68. Toxin | Module 2-C: Objective 1—Define the term infection |
| 69. Transient microorganism | Module 1-C: Objective 5—Distinguish among normal flora, resident flora, and transient flora |
| 70. Transitory/temporary | |
| 71. Vector | Module 2-C: Objective 7—Distinguish between direct and indirect contact in the transmission of pathogens |
| **B. Pathogenicity**<br>1. Aggressiveness and virulence of the pathogen<br>2. Size and composition of the microbe population<br>3. Physical environment<br>4. Susceptibility of the host | Module 2-C: Objective 4—Select factors influencing the occurrence of infection |
| **C. Inflammatory process**<br>1. Signs of inflammation<br>a. Redness<br>b. Heat<br>c. Swelling<br>d. Pain<br>2. Physiology<br>a. Increased blood supply to the site and dilation of blood vessels = heat and increased # WBCS + phagocytosis<br>b. Edema, swelling from fluid formation = pain<br>c. Accumulation of dead/living microbes + WBCS = pus | Module 2-C: Objective 15—List the symptoms of acute inflammatory response |
| 3. Infection<br>a. Invasion<br>b. Localization<br>c. Resolution | Module 2-C: Objective 9—Complete statements concerning the effects of infection on a human host |

## PHARMACOLOGY

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| **I. Medication measurements** | |
| **A.Conversion and equivalent tables** | |
| 1. Metric system<br>a. Terminology | Module 2-D: Objective 1—Select true statements concerning the metric system of measurement; Objective 2—Match metric prefixes with their correct amounts; Objective 3—State metric equivalents of weight, capacity, and length; Objective 4—List advantages of the metric system; Objective 5—State abbreviations for metric weights and measures; Assignment Sheet 2—Use abbreviations for metric weight and measures |
| b. Conversions | Module 2-D: Student Supplement 1—Use weight conversion chart; Student Supplement 2—Use capacity conversion chart; Student Supplement 3—Use length conversion chart; Assignment Sheet 1—Solve problems concerning metric equivalents |
| 2. Apothecary system<br>a. Terminology | Module 2-D: Objective 3—State metric equivalents of weight, capacity, and length |
| b. Conversions | Module 2-D: Student Supplement 1—Use weight conversion chart; Student Supplement 2—Use capacity conversion chart; Student Supplement 3—Use length conversion chart; Assignment Sheet 1—Solve problems concerning metric equivalents |
| 3. Household system<br>a. Terminology | Module 2-D: Objective 3—State metric equivalents of weight, capacity, and length |
| b. Conversions | Module 2-D: Student Supplement 1—Use weight conversion chart; Student Supplement 2—Use capacity conversion chart; Student Supplement 3—Use length conversion chart; Assignment Sheet 1—Solve problems concerning metric equivalents |
| 4. Temperature conversion | Module 2-D: Objective 6—Distinguish between systems for measuring temperature |
| a. Fahrenheit to celsius<br>b. Celsius to fahrenheit | Module 2-D: Student Supplement 4—Use temperature conversion chart |
| 5. Units of measure<br>a. Oz<br>b. Dram<br>c. Ml, cc<br>d. L<br>e. Gtt<br>f. Kg<br>g. Mg | Module 2-D: Objective 7—Write the correct abbreviations pertaining to the handling of medications |

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| **B. Measurement and delivery**<br>1. Syringes<br>a. Slip-tip<br>b. Luer-lock<br>c. Irrigating<br>d. Asepto<br>e. Other<br>2. Metal containers<br>3. Graduate pitcher<br>4. Plastic containers | Module 3-D: Objective 2—Select the true statements concerning the characteristics of syringes; Objective 3—Identify the parts of a syringe; Objective 4—Complete statements concerning types of syringes used for irrigating; Objective 5—Identify the types of syringes used for injecting and aspirating; Objective 6—Distinguish between the types of syringe tips used for injecting and aspirating; Objective 7—Select true statements concerning the characteristics of hypodermic needles; Objective 8—Identify the parts of a hypodermic needle |
| **C. Basic mathematics** | |
| 1. Roman numerals | Module 1-D: Objective 21—Convert Roman numerals to Arabic numerals; Assignment Sheet 16—Convert Roman numerals to Arabic numerals |
| 2. Fractions | Module 1-D: Objective 8—Distinguish among types of fractions; Objective 9—Reduce fractions to lowest terms; Objective 10—Convert fractions and mixed numbers; Objective 11—Add fractions to solve problems; Objective 12—Subtract fractions to solve problems; Objective 13—Multiply fractions to solve problems; Assignment Sheet 5—Reduce fractions to lowest terms; Assignment Sheet 6—Convert fractions to mixed numbers; Assignment Sheet 7—Add fractions; Assignment Sheet 8—Subtract fractions; Assignment Sheet 9—Multiply fractions |
| 3. Decimals | Module 1-D: Objective 14—Label place values in a decimal number; Objective 15—Add decimal numbers to solve problems; Objective 16—Subtract decimal numbers to solve problems; Objective 17—Multiply decimal numbers to solve problems; Objective 18—Divide decimal numbers to solve problems; Assignment Sheet 10—Add decimal numbers; Assignment Sheet 11—Subtract decimal numbers; Assignment Sheet 12—Multiply decimal numbers; Assignment Sheet 13—Divide decimal numbers |
| 4. Ratios<br>5. Proportions | Module 1-D: Objective 1—Match terms associated with math and measuring to their correct definitions |
| 6. Percentages | Module 1-D: Objective 19—Convert fractions and percentages; Objective 20—Solve percentage problems; Assignment Sheet 14—Convert fractions and percentages; Assignment Sheet 15—Solve percentage problems |
| **D. Dosage calculations**<br>1. Calculating unit per milliliter dosages<br>2. Calculating amount/dosage delivered | |
| **E. Mixing medications**<br>1. Combining medications<br>2. Reconstituting medications<br>3. Diluting medications | |

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| **II. Terminology**<br>**A. General definitions**<br>1. Pharmacology<br>2. Pharmacokinetics<br>a. Absorption<br>b. Distribution<br>c. Biotransformation<br>d. Excretion<br>3. Pharmacodynamics<br>a. Onset<br>b. Peak affect<br>c. Duration of action<br>d. Indication<br>e. Contraindication | Module 4-D: Objective 1—Define pharmacology, pharmacodynamics, and pharmacokinetics |
| **B. Types of medication actions/effects**<br>1. Actions<br>a. Synergist<br>b. Agonist<br>c. Antagonist<br>d. Additive<br>2. Effects<br>a. Relaxation<br>b. Sedation<br>c. Amnesia<br>d. Neuroleptic<br>e. Analgesia<br>f. Drying secretions<br>g. Gastric acid reduction<br>h. Vagal blockade<br>i. Other | Module 5-D: Objective 19—List narcotic antagonists used intraoperatively<br>Module 5-D: Objective 5—Complete statements concerning classifications of premedications |
| **C. Abbreviations**<br>1. Stat<br>2. IV<br>3. IM<br>4. SC<br>5. PO<br>6. OS, OD, OU<br>7. Qid, bid, tid<br>8. PRN<br>9. NPO<br>10. Other | Module 2-D: Objective 7—Write the correct abbreviations pertaining to the handling of medications |
| **III. Medications**<br>**A. Medication nomenclature**<br>1. Chemical name<br>2. Generic name<br>3. Trade or brand name | Module 4-D: Objective 5–-Distinguish among the types of names that a drug may have |
| **B. Medication control classifications**<br>1. Controlled substance<br>2. Prescription medications<br>3. Nonprescription medications—over the counter (OTC)<br>4. Other | |

# Crosswalk to AST Core Curriculum

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| C. **Medication/solution violations**<br>1. Narcotic precautions<br>2. Personnel negligence<br>3. Consequences to patient | Module 4-D: Objective 13—Complete statements concerning narcotic analgesics |
| D. **Laws, policies and procedures**<br>1. Hospital policies and procedures<br>2. State laws<br>3. Verbal orders as accepted practice | Module 4-D: Objective 23—Select true statements concerning the care and handling of medications |
| E. **Medication publications**<br>1. *Physician's Desk Reference* (PDR)<br>2. *The National Formulary*<br>3. *Pharmacopedia of the United States of America* - (the U.S.P.)<br>4. *National Code Directory*<br>5. *America Hospital Formulary Service Index* - (AHFS) | Module 4-D: Objective 6—Select common sources of information concerning drugs; Assignment Sheet 2—Use a drug information reference |
| F. **Sources of medications**<br>1. Plants<br>2. Animals<br>3. Minerals<br>4. Laboratory synthesis<br>5. Biotechnology | Module 4-D: Objective 4—List primary sources of drugs |
| G. **Pharmaceutical preparations (drug forms)**<br>1. Gas<br>2. Liquid<br>a. Solution<br>b. Suspension<br>c. Emulsion<br>d. Solid<br>e. Semisolid | Module 4-D: Objective 3—List the types of drug preparations with their correct descriptions |
| H. **Routes of administration**<br>1. IV<br>2. IM<br>3. SC<br>4. PO<br>5. Intrathecal<br>6. Instillation<br>7. Injection<br>8. Topical application | Module 4-D: Objective 8—Complete statements concerning the route of administration of drugs |
| IV. **Care & handling of medications and solutions**<br>A. **Medication identification**<br>1. Label information<br>2. Trade name<br>3. Generic name<br>4. Concentration<br>5. Amount<br>6. Expiration date<br>7. Directions for reconstitution/dilution<br>8. Storage/handling precautions/warnings<br>9. Route of administration<br>10. Circulator duty/responsibility<br>11. Surgical technologist (STSR) | Module 4-D: Objective 23—Select true statements concerning the care and handling of medications |

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| **B. Medication preparation** | Module 4-D: Objective 23—Select true statements concerning the care and handling of medications |
| 1. Nonsterile area<br>a. Draw up medication into a syringe | Module 3-D: Job Sheet 1—Fill an irrigating syringe; Job Sheet 2—Draw up medication held by circulator |
| 2. Nonsterile to sterile field transfer<br>a. Draw up medication into a syringe | Module 3-D: Job Sheet 2—Draw up medication held by circulator |
| b. Accept medication into the sterile field | Module 4-D: Objective 24—Complete statements concerning the procedure for the surgical technologist to accept medication from the circulator; Job Sheet 1—Receive medication onto the sterile field |
| **C. Techniques of identification**<br>1. Labeling devices<br>2. Containers on sterile field<br>3. Identifying medication or solution to other team members | Module 4-D: Objective 23—Select true statements concerning the care and handling of medications; Job Sheet 1—Receive medication onto the sterile field |
| **V. Medications used in surgery** | |
| **A. Classifications of agents** | Module 4-D: Objective 9—Match classifications of common drugs used in surgery with their actions; Assignment Sheet 1—Classify various drugs according to type (all items in left column are covered in this objective and AS; some are also covered in separate objectives as noted below and on next two pages) |
| 1. Analgesics<br>2. Narcotics<br>3. Narcotic antagonists | Objective 13—Complete statements concerning narcotic analgesics; Objective 5-D: Objective 5—Complete statements concerning classifications of premedications; Objective 18—List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia; Objective 19—List narcotic antagonists used intraoperatively |
| 4. Analgesic antipyretic agents | Module 4-D: Objective 2—List purposes of drugs |
| 5. Sedative-hypnotic agents<br>6. Tranquilizers<br>7. Anticonvulsants<br>8. Central nervous system stimulants<br>a. Analeptics<br>b. Emetics<br>9. Antiemetics and antihistamines | Module 5-D: Objective 5—Complete statements concerning classifications of premedications; Objective 18—List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia |

**A. Classifications of agents (cont.)**

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| 10. Autonomic agents<br>a. Adrenergic (alpha and beta)<br>b. Adrenergic blockers<br>c. Cholinergics<br>d. Cholinergic blockers | Objective 22—Match miscellaneous drugs used in surgery for emergency situations with their correct descriptions |
| 11. Cardiac medications<br>a. Inotropic agents<br>b. Antiarrhythmics<br>c. Coronary dilators<br>d. Other | |
| 12. Coagulants and hemostatics | Module 4-D: Objective 11—Complete statements concerning the characteristics of hemostatic agents |
| 13. Anticoagulants and fibrinolytics | Module 4-D: Objective 10—Select true statements concerning the characteristics of anticoagulants |
| 14. IV fluids | Module 4-D: Objective 20—Complete statements concerning characteristics of intravenous solutions |
| 15. Blood replacement<br>a. Whole blood<br>b. Component therapy<br>c. Autologous blood<br>d. Non-blood replacements/plasma expanders | Module 4-D: Objective 21—Complete statements concerning blood replacements, blood components, and blood substitutes; Objective 5-D: Objective 30—Complete statements concerning hemostasis and blood replacement |
| 16. Diuretics | Module 4-D: Objective 15—Select true statements concerning characteristics of diuretics |
| 17. Ophthalmic medications<br>a. Enzymes<br>(1) Zonulysis<br>(2) Local anesthesia adjuncts<br>b. Irrigating solutions<br>c. Mydriatics/cycloplegics<br>d. Antibiotics<br>e. Viscoelastics/lubricants<br>f. Dyes<br>g. Other | Module 4-D: Objective 14—Match drugs used for ophthalmic surgery with their correct uses |
| 18. Gastric medications<br>a. H2-receptor blockers<br>b. Other | Module 4-D: Objective 9—Match classifications of common drugs used in surgery with their actions; Module 5-D: Objective 5—Complete statements concerning classifications of premedications |
| 19. Obstetrical agents<br>a. Oxytocics<br>b. RhoGAM<br>c. Other | Module 4-D: Objective 17—Complete statements concerning characteristics of hormones |

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| **A. Classifications of agents (cont.)** | |
| 20. Hormones<br>a. Sex hormones<br>b. Corticosteroids<br>c. Insulin/glucagon<br>d. Prostaglandins<br>e. Other | Module 4-D: Objective 16—Select true statements concerning characteristics of steroids; Objective 17—Complete statements concerning characteristics of hormones |
| 21. Anti-infective agents<br>a. Penicillins/cephalosporins<br>b. Sulfonamides<br>c. Polymyxins<br>d. Aminoglycoside<br>e. Antimicrobial<br>f. Tetracyclines<br>g. Antifungals<br>h. Other | Module 4-D: Objective 12—Select true statements concerning the characteristics of antibiotic/anti-infectives commonly used in surgery |
| 22. Contrast media | Module 4-D: Objective 18—Complete statements concerning characteristics of contrast media |
| 23. Antineoplastic chemotherapy | |
| 24. Dyes | Module 4-D: Objective 19—Match common dyes used in surgery with their correct descriptions |
| 25. Irrigation solutions | |

## ANESTHESIA

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| **I. Anesthesia administration**<br>**A. Selection**<br>1. American Society of Anesthesiologists (ASA) risk classification<br>2. Patient factors<br>a. Age<br>b. Height and weight<br>c. General health<br>d. Comorbid conditions<br>e. Current medications<br>f. Allergies<br>g. Substance abuse<br>h. Emergency conditions<br>i. Patient's psychological/emotional state<br>j. Other<br>3. Type of procedure (duration and required position)<br>4. Surgeon's preference<br>5. Patient's preference<br>6. Anesthesia provider's preference<br>7. Other | Module 5-D: Objective 4—Complete statements concerning the selection of preoperative medications; Objective 6—Select true statements concerning anesthesia |

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| **B. Preoperative medications**<br>1. Narcotics<br>2. Sedatives-hypnotic agents<br>3. Tranquilizers<br>4. Analgesics<br>5. Anticholinergics<br>6. Antacid/H2-receptor blocking agents<br>7. Other | Module 5-D: Objective 5—Complete statements concerning classifications of premedications |
| **C. Types of anesthesia**<br>1. General<br>2. Balanced<br>3. Neuroleptic analgesia | Module 5-D: Objective 8—Distinguish among types of anesthetics (covers items 1–5 in the left column) |
| 4. Regional<br>a. Spinal/caudal<br>b. Epidural<br>c. Nerve block<br>d. Bier block<br>5. Local<br>a. Injection<br>b. Topical | Module 5-D: Objective 13—Match types of local or regional anesthetics with their correct descriptions (covers items 4 and 5 in the left column) |
| 6. Positioning for administration<br>a. General<br>b. Regional<br>c. Local<br>d. Other | Module 5-D: Objective 13—Match types of local or regional anesthetics with their correct descriptions |
| 7. Anesthesia delivery<br>a. Delivery devices<br>(1) Mask<br>(2) Laryngeal mask airway<br>(3) Endotracheal intubation<br>b. Assistive devices<br>(1) Laryngoscope<br>(a) Rigid<br>(b) Flexible<br>(2) McGill forceps<br>(3) Stylet<br>(4) Oral airway<br>(5) Nasal airway<br>(6) Nerve stimulator | |
| c. Other techniques<br>(1) Cryoanesthesia<br>(2) Hypnoanesthesia<br>(3) Acupuncture<br>(4) Other | Module 5-D: Objective 15—Match other anesthetic techniques occasionally used with their correct descriptions |
| **D. Methods of administration**<br>1. Intravenous<br>2. Inhalation<br>3. Intramuscular<br>4. Intrathecal<br>5. Epidural<br>6. Infiltration<br>7. Topical<br>8. Other | Module 5-D: Objective 9—Distinguish between methods of administering a general anesthetic |

**E. Anesthetic medications**

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| 1. Inhalation agents<br>a. $O_2$<br>b. $N_2O$<br>c. Fluothane<br>d. Enthrane<br>e. Isoflurane<br>f. Sevoflurane<br>g. Desflurane<br>2. Intravenous anesthetics<br>a. Induction barbiturates<br>b. Thiopental sodium<br>c. Methohexital sodium<br>d. Propofol<br>e. Etomidate | Module 5-D: Objective 10—List agents used for general anesthesia |
| 3. Opiates and synthetics<br>a. Meperidine<br>b. Morphine<br>c. Fentanyl<br>d. Sufentanil<br>e. Alfentanil<br>f. Remifentanil<br>g. Other | Module 5-D: Objective 18—List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia |
| 4. Neuromuscular blocking agents | Module 5-D: Objective 16—Complete statements concerning the characteristics of muscle relaxant drugs |
| a. Depolarizing<br>(1) Succinylcholine<br>b. Non-depolarizing<br>(1) Atracurium<br>(2) Rocuronium<br>(3) Vecuronium<br>(4) Pancuronium<br>(5) Other<br>5. NMB reversal agents<br>a. Edrophonium<br>b. Neostigmine | Module 5-D: Objective 17—Distinguish between types of muscle relaxants |
| 6. Antimuscarinics/anticholinergics<br>a. Atropine<br>b. Robinul<br>7. Antiemetics | Module 5-D: Objective 5—Complete statements concerning classifications of premedications |
| 8. Sedative/tranquilizers<br>a. Diazepam<br>b. Midazolam | Module 5-D: Objective 18—List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia |

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| **E. Anesthetic medications (cont.)**<br>9. Reversal/antagonist agents<br>a. Naloxone<br>b. Flumazenil | Module 5-D: Objective 19—List narcotic antagonists used intraoperatively |
| 10. Dissociative agents | |
| 11. Neuroleptic agents<br>a. Droperidol | Module 5-D: Objective 5—Complete statements concerning classifications of premedications |
| 12. Local/topical agents<br>a. Amides<br>(1) Lidocaine<br>(2) Bupivacaine<br>(3) Mepivacaine<br>b. Esters<br>(1) Cocaine<br>(2) Pontocaine/tetracaine<br>(3) Cetacaine<br>(4) Other | Module 5-D: Objective 14—List agents used for local or regional anesthesia |
| **F. Roles during administration**<br>1. Hospital policy<br>2. Assisting anesthesia personnel<br>a. General anesthesia<br>b. Spinal/epidural anesthesia<br>c. Regional anesthesia<br>d. Local anesthesia<br>3. Dispensing<br>4. Documenting<br>5. Monitoring | Module 5-D: Objective 21—Discuss circulator and scrub personnel roles during administration of anesthesia |
| **G. Phases of general anesthesia**<br>1. Induction<br>2. Maintenance<br>3. Emergence<br>4. Recovery | Module 5-D: Objective 11—List the four phases of general anesthesia |
| **H. Stages of general anesthesia**<br>1. Stage 1<br>2. Stage 2<br>3. Stage 3<br>4. Stage 4 | Module 5-D: Objective 12—Match stages of general anesthesia with their correct descriptions |
| **I. Adjuncts to anesthesia**<br>1. Hypothermia/hyperthermia unit<br>2. Fluid warming devices<br>3. Fluid pumps<br>4. Infusion control devices<br>5. Double-cuffed pneumatic tourniquet<br>6. Other | Module 5-D: Objective 28—Match equipment used as adjuncts to anesthesia with their uses |
| **J. Anesthesia equipment**<br>1. Anesthesia machine<br>2. Vaporizer<br>3. Ventilator<br>4. Rebreathing apparatus<br>5. Scavenging system | Module 5-D: Objective 27—Match OR anesthesia equipment used for delivering anesthetics and/or monitoring the patient with their correct descriptions |

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| **K. Monitoring devices and methods**<br>1. Electrocardiogram<br>2. Blood pressure devices<br>3. Bispectral index monitor (BIS)<br>4. Pulmonary artery catheter<br>5. Central venous pressure<br>6. Temperature monitors<br>a. Probes<br>b. Foley temperature catheters<br>c. Skin temperature strip<br>7. Pulse oximeter<br>8. Controlled ventilation<br>9. System for anesthetic and respiratory analysis (SARA)<br>10. Stethoscopes and Doppler<br>11. Arterial blood gases<br>12. Other | Module 5-D: Objective 27—Match OR anesthesia equipment used for delivering anesthetics and/or monitoring the patient with their correct descriptions |
| **L. Complications of anesthesia** | Module 5-D: Objective 22—List possible complications of anesthesia (all items in left column are covered in this objective; some are also covered in separate objectives as noted below) |
| 1. Allergic reaction | Module 5-D: Objective 25—Complete statements concerning anaphylactic reactions |
| 2. Aspiration<br>3. Sellick's maneuver<br>4. Laryngospasm/bronchospasm | |
| 5. Malignant hyperthermia<br>6. Shock<br>a. Hemorrhagic<br>b. Cardiogenic | Module 5-D: Objective 23—Select true statements concerning malignant hyperpyrexia—malignant hyperthermia syndrome |
| 7. Cardiac dysrhythmias<br>8. Cardiac arrest<br>9. Other | Module 5-D: Objective 26—Distinguish among actions of the surgical team if cardiac arrest occurs on the operating room table |

## COMPUTER SKILLS

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| **I. Computer hardware** | |
| **A. Basic computer components** | Module 1-E: Objective 2—Identify the basic components of a computer system (all items in left column are covered in this objective; some are also covered in separate objectives as noted below) |
| 1. On/off | Module 1-E: Assignment Sheet 1—Examine computer operating manual(s) for basic operating procedures; Job Sheet 1—Start/boot the computer |
| 2. Drives<br>a. C: drive (hard)<br>b. A: drive (floppy)<br>c. D: drive (CD-ROM)<br>d. E: drive (Zip) | Module 1-E: Objective 6—Match computer storage devices to their correct descriptions |

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| **A. Basic computer components (cont.)** | |
| 3. Monitor | Module 1-E: Objective 4—Complete statements concerning output devices |
| 4. Keyboard | Module 1-E: Objective 3—Match types of input devices to their correct uses |
| 5. Mouse | Module 1-E: Objective 3—Match types of input devices to their correct uses; Student Supplement 1—Operating a mouse |
| 6. Printer | Module 1-E: Objective 4—Complete statements concerning output devices |
| 7. Modem | Module 1-E: Objective 14—Complete statements concerning the basics of using the Internet |
| 8. Speakers | Module 1-E: Objective 4—Complete statements concerning output devices |
| 9. Scanner | Module 1-E: Objective 3—Match types of input devices to their correct uses |
| **II. Computer applications** | |
| **A. Word processing** | Module 1-E: Objective 9—List the characteristics of word-processing software; Assignment Sheet 2—Examine word-processing software manual for basic operations (all items in left column are covered in this objective; some are also covered in separate objectives as noted below and on next page) |
| 1. Desktop<br>2. Toolbars | Module 1-E: Objective 8—Match terms related to the computer desktop to their correct descriptions |
| 3. Finding/opening files | Module 1-E: Job Sheet 2—Open and close a program; Job Sheet 3—Create a word-processed document; Job Sheet 4—Practice using the formatting toolbar |
| 4. Text manipulation<br>a. Changing font style/size<br>b. Changing case<br>c. Cut/copy/paste<br>d. Creating footnotes/endnotes<br>e. Underlining/italicizing/bolding<br>f. Numbering of text<br>g. Spacing of text<br>h. Hanging indents | Module 1-E: Objective 10—Match basic word-processing software text-tool operations to their correct functions; Objective 11—Match page-setup features to their correct descriptions; Objective 12—Identify the primary functions of the icons located on a word-processing toolbar; Objective 13—Match the primary functions on a word-processing toolbar to their icons; Job Sheet 4—Practice using the formatting toolbar |
| 5. Page numbering | Module 1-E: Job Sheet 4—Practice using the formatting toolbar |
| 6. Spell/grammar check | Module 1-E: Job Sheet 3—Create a word-processed document |

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| **A. Word processing (cont.)** | |
| 7. Saving files | Module 1-E: Job Sheet 3—Create a word-processed document; Job Sheet 4—Practice using the formatting toolbar |
| 8. Scrolling | Module 1-E: Job Sheet 4—Practice using the formatting toolbar |
| 9. Printing documents | Module 1-E: Job Sheet 3—Create a word-processed document; Job Sheet 4—Practice using the formatting toolbar |
| 10. Closing files/applications | Module 1-E: Job Sheet 2—Open and close a program; Job Sheet 3—Create a word-processed document; Job Sheet 4—Practice using the formatting toolbar |
| **B. Graphics**<br>1. Saving<br>2. Importing<br>3. Manipulation | Module 1-E: Job Sheet 5—Insert graphic and footnote/endnote in word-processed document |
| **C. Internet** | Module 1-E: Objective 14—Complete statements concerning the basics of using the Internet |
| 1. E-mail | Module 1-E: Objective 15—Select true statements concerning e-mail; Job Sheet 7—Use e-mail |
| 2. Research<br>3. Saving graphics<br>4. Saving information | Module 1-E: Job Sheet 6—Search the Internet |

## ELECTRICITY

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| **I. Definition** | Module 2-E: Objective 1—Define electricity |
| **II. Terms** | |
| **A. Circuit** | Module 2-E: Objective 16—Complete statements concerning facts about electrical shock |
| **B. Conductor** | Module 2-E: Objective 3—Select true statements concerning the principles of electron flow |
| **C. Current**<br>**D. Frequency** | Module 2-E: Objective 7—Match terms related to electrical current with their correct descriptions |
| **E. Ground** | Module 2-E: Objective 12—Match the wires contained in an electrical receptacle with their correct descriptions |
| **F. Insulator** | Module 2-E: Objective 3—Select true statements concerning the principles of electron flow |
| **G. Isolated circuit** | Module 2-E: Objective 16—Complete statements concerning facts about electrical shock |
| **H. Radio frequency** | Module 2-E: Objective 7—Match terms related to electrical current with their correct descriptions |

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| **II. Terms (cont.)** | |
| I. Receptacle | Module 2-E: Objective 12—Match the wires contained in an electrical receptacle with their correct descriptions |
| J. Resistance | Module 2-E: Objective 16—Complete statements concerning facts about electrical shock |
| K. Voltage | Module 2-E: Objective 8—Select true statements concerning measuring electricity |
| **III. Basic principle of electrical flow** | Module 2-E: Objective 3—Select true statements concerning the principles of electron flow |
| **IV. Types of current**<br>A. Direct current<br>B. Alternating current<br>C. Cycle<br>D. Frequencies | Module 2-E: Objective 7—Match terms related to electrical current with their correct descriptions |
| **V. Electrical receptacles**<br>A. Hot wire<br>B. Neutral wire<br>C. Ground wire | Module 2-E: Objective 12—Match the wires contained in an electrical receptacle with their correct descriptions |

## PHYSICS

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| **I. Physics** | |
| **A. Mechanics**<br>1. Study of motion<br>2. Projectile and satellite motion<br>3. Newton's Law of Motion<br>4. Newton's Law of Gravity<br>5. Momentum<br>6. Energy and work | Module 3-E: Objective 1—Distinguish among gravitational, magnetic, and electrical forces; Objective 2—Complete statements concerning pressure; Objective 3—Match Newton's three laws of motion to their correct descriptions; Objective 4—Explain why blood separates in a centrifuge; Objective 5—Select true statements concerning types of simple machines; Objective 6—Explain center of gravity and its effect on posture and occupational safety; Objective 7—Complete statements concerning the modes of motion; Student Supplement 1—Motion and the human body; Assignment Sheet 1—Apply motion and leverage to the workplace |
| **B. Properties of matter**<br>1. Atomic nature of matter<br>2. Solids<br>3. Liquids<br>4. Gases and plasmas | Module 3-E: Objective 8—Select true statements concerning the composition of matter; Objective 9—Select true statements concerning matter's three changes of state; Student Supplement 2—Understanding matter and energy; Assignment Sheet 2—Evaluate states of matter |
| **C. Heat**<br>1. Temperature, heat and expansion<br>2. Heat transfer<br>3. Change of state | Module 3-E: Objective 10—Complete statements concerning heat transfer; Objective 11—Explain cryosurgery and its advantages; Assignment Sheet 2—Evaluate states of matter |

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| **D. Sound, vibrations and waves**<br>1. Simple harmonic motion<br>2. Vibrating strings | Module 3-E: Objective 12—Complete statements concerning waveforms; Objective 13—Describe how ultrasound scans work; Student Supplement 3—Waves; Student Supplement 4—Sound waves; Assignment Sheet 3—Apply electromagnetic waveforms to medicine; Job Sheet 2—Create waveform polarization |
| **E. Electricity and magnetism**<br>1. Electrostatics<br>2. Electric current<br>3. Magnetism<br>4. Electromagnetic interactions | Module 3-E: Objective 17—Complete statements concerning magnetism characteristics; Objective 18—Distinguish between static and dynamic electricity; Objective 19—Complete statements concerning electricity and electric current; Objective 20—List the physical and biological effects of electric current that prove helpful in medicine; Student Supplement 6—Electricity and surgery; Assignment Sheet 3—Apply electromagnetic waveforms to medicine; Job Sheet 2—Create waveform polarization |
| **F. Light**<br>1. Reflection and refraction<br>2. Color<br>3. Light waves<br>4. Light emission | Module 3-E: Objective 15—Complete statements concerning the dual nature of light; Objective 16—Match the electromagnetic spectrum types to their correct uses; Objective 21—Complete statements concerning fiber optics; Objective 22—Describe how optical fiber is used in endoscopic surgeries; Objective 23—Complete statements concerning the use of lasers in surgery; Objective 24—Match laser types to their correct descriptions; Student Supplement 5—Electromagnetic spectrum; Assignment Sheet 4—Research lasers |
| **G. Modern physics**<br>1. Atomic and nuclear physics<br>2. Relativity | Module 3-E: Objective 25—Select true statements concerning the use of nuclear medicine in surgery; Objective 26—Complete statements concerning CT scans; Objective 27—Explain the importance of setting irradiation and measuring dosage; Objective 28—List methods for protecting against occupational irradiation; Assignment Sheet 5—Visit a hospital to view radiation from preparation to disposal; Assignment Sheet 6—Recognize the implications of using nuclear medicine |
| **ROBOTICS** | |
| **I. Robotics**<br>**A. Basic concepts** | |
| 1. Terminology | Module 4-E: Terminology is covered throughout this module. |
| 2. Design | Module 4-E: Student Supplement 3—Robotic design |
| 3. Robotic components and mechanisms | Module 4-E: Objective 21—List the primary serial robotic components; Objective 22—Identify each of the components in a telesurgical interaction; Objective 23—Describe the functions of sensors and actuators; Objective 24—Match sensor types to their correct descriptions; Objective 25—Describe the function of the robotic components in the articulated mechanical system (AMS); continued on next page |

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| **A. Basic concepts (cont.)** | |
| 3. Robotic components and mechanisms (cont.) | Module 4-E: Objective 26—Match means of driving robotic arms to their correct descriptions; Objective 34—Identify components of robotic control; Objective 35—List the options available for the user interface control and for monitoring surgical process; Objective 36—List sensate options that should be available for an optimal haptics interface design; Student Supplement 4—System components; Student Supplement 6—Robotic control; Assignment Sheet 3—Identify robotic components |
| 4. Preparation/positioning of the robotic arm(s) | Module 4-E: Objective 25—Describe the function of the robotic components in the articulated mechanical system (AMS); Objective 27—Describe the sequence of events leading to robotic manipulation; Objective 28—List the four basic types of movement; Objective 29—Define yaw, pitch, and roll; Objective 30—Match the degrees of freedom in the human arm to their correct motions; Objective 31—Complete statements comparing degrees of freedom in a rigid endoscope and a flexible endoscope; Objective 32—Complete statements concerning the degrees of freedom in the jointed medical robotic arm; Objective 33—Complete statements concerning the four possible robotic control modes; Objective 41—Arrange in order the four basic preparatory steps for MIS or robotic procedures; Objective 42—Arrange in order the steps to properly prepare and position robotic systems; Objective 43—Complete statements concerning issues that must be addressed for integrating robotics into OR; Student Supplement 5—Robotic motion; Assignment Sheet 4—Identify robotic motion; Job Sheet 1—Demonstrate degree of freedom in the human arm |
| 5. Decontamination and sterilization of robotic components | Module 4-E: Objective 42—Arrange in order the steps to properly prepare and position robotic systems; Student Supplement 7—Robotics in the operating suite |
| **B. Clinical applications** | All assignment sheets and the job sheet in this module cover clinical applications of robotics. |
| 1. Robotics in minimally invasive surgery | Module 4-E: Objective 1—Complete statements concerning the trend towards minimally invasive surgery; Objective 2—List the four drawbacks of minimally invasive surgery; Objective 3—Complete statements concerning surgical categories more easily adapted to MIS techniques; Objective 4—List the fundamental impacts digital information has had on MIS technologies; Objective 5—List the conditions which make the use of a robot instead of a human attractive; Objective 6—Match the robotic characteristics that promote their use in surgical procedures to their correct descriptions; Objective 7—Arrange in order the steps for integrating robotics into surgical procedures; Objective 8—Describe the benefits of using robotics in MIS; Objective 17—List the primary issues in minimally invasive surgery; Student Supplement 1—Minimally invasive surgery |

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| **B. Clinical applications (cont.)** | |
| 2. Robotics in the operating suite | Module 4-E: Objective 9—Identify the types of surgery where robotics can play a significant role; Objective 10—List the pre-operative benefits of using robotics; Objective 11—Complete statements concerning the inter-operative benefits of using robotics; Objective 12—Select true statements concerning the post-operative benefits of using robotics; Objective 13—Complete statements contrasting open incisions and MIS incisions; Objective 18—Compare surgical technique in MIS with and without robotics; Objective 19—Describe the four basic types of surgical robots; Objective 20—Describe latency and its impact on telesurgery; Objective 38—Identify each of the primary players during surgery; Objective 39—List the four basic imaging tools used during an MIS procedure; Objective 40—List the surgical tools potentially used during an MIS procedure; Student Supplement 2—Medical robotics; Student Supplement 7—Robotics in the operating suite |
| 3. Troubleshooting | |

## EMERGENCY PROCEDURES

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| **I. Malignant hyperthermia**<br>A. Etiology<br>B. Clinical manifestations<br>C. Management<br>D. Clinical intervention<br>E. Pharmacological interventions<br>F. Prevention | Module 5-D: Objective 23—Select true statements concerning malignant hyperpyrexia—malignant hyperthermia syndrome |
| **II. Cardiac arrest/CPR**<br>A. Etiology<br>B. Clinical manifestations<br>C. Management<br>D. Clinical intervention<br>E. Pharmacological interventions<br>F. Prevention | Module 5-D: Objective 26—Distinguish among actions of the surgical team if cardiac arrest occurs on the operating room table |
| **III. Hemolytic reaction**<br>A. Etiology<br>B. Clinical manifestations<br>C. Management<br>D. Clinical intervention<br>E. Pharmacological interventions<br>F. Prevention | Module 5-D: Objective 24—Complete statements concerning hemolytic reactions |
| **IV. Anaphylactic reaction**<br>A. Etiology<br>B. Clinical manifestations<br>C. Management<br>D. Clinical intervention<br>E. Pharmacological interventions<br>F. Prevention | Module 5-D: Objective 25—Complete statements concerning anaphylactic reactions |

## SURGICAL WOUND CLASSIFICATION

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| **I. Wound classifications according to their degree of microbial contamination**<br>A. Class I: Clean<br>B. Class II: Clean contaminated<br>C. Class III: Contaminated<br>D. Class IV: Dirty/infected<br>**II. Examples of surgical procedures that fall into each category** | Module 3-C: Objective 7—Match classes of surgical (operative) wounds with their correct descriptions; Assignment Sheet 1—Classify surgical and traumatic wounds |

## HEMOSTASIS

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| **I. Principles**<br>A. Blood clotting mechanisms<br>B. Blood components<br>C. Monitoring blood loss | Module 5-D: Objective 30—Complete statements concerning hemostasis and blood replacement |
| **II. Methods of hemostasis**<br>**A. Mechanical**<br>1. Hemostatic instruments<br>2. Ligatures<br>3. Pressure<br>4. Bone wax<br>5. Clip<br>6. Tourniquet<br>7. Sponges<br>8. Pledgets | Module 5-D: Objective 30—Complete statements concerning hemostasis and blood replacement |
| **B. Chemical**<br>1. Absorbable gelatin<br>2. Collagen<br>3. Oxidized cellulose<br>4. Silver nitrate<br>5. Epinephrine<br>6. Thrombin | Module 4-D: Objective 11—Complete statements concerning the characteristics of hemostatic agents; Module 5-D: Objective 30—Complete statements concerning hemostasis and blood replacement |
| **C. Thermal**<br>1. Electrosurgical unit<br>2. Harmonic scalpel<br>3. Argon beam coagulator<br>4. Laser | Module 5-D: Objective 30—Complete statements concerning hemostasis and blood replacement; Module 3-E: Objective 22—Describe how optical fiber is used in endoscopic surgeries |
| **III. Techniques**<br>**A. Hypothermia** | Module 5-D: Objective 15—Match other anesthetic techniques occasionally used with their correct descriptions |
| **B. Hypotension** | Module 5-D: Objective 24—Complete statements concerning hemolytic reactions |

## WOUND HEALING

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| **I. Wound Healing**<br>**A. Historical background** | |
| **B. Definitions** | |
| 1. Adhesions | Module 3-C: Objective 3—Distinguish among types of wound healing |
| 2. Dehiscence | Module 3-C: Objective 9—Describe factors that present possible complications to the wound-healing process; Objective 10—Complete statements concerning the effects of operative technique on wound healing |
| 3. Dead space | Module 3-C: Objective 10—Complete statements concerning the effects of operative technique on wound healing |
| 4. Debridement | Module 3-C: Objective 3—Distinguish among types of wound healing |
| 5. Granuloma | |
| 6. Collagen | Module 3-C: Objective 4—Complete statements concerning the phases of first intention wound healing |
| 7. Evisceration | Module 3-C: Objective 11—Complete statements concerning the effects of operative technique on wound healing |
| 8. Hemostasis | Module 3-C: Objective 10—Complete statements concerning the effects of operative technique on wound healing |
| 9. Scar | Module 3-C: Objective 3—Distinguish among types of wound healing |
| 10. Necrosis | Module 3-C: Objective 10—Complete statements concerning the effects of operative technique on wound healing |
| 11. Trauma | Module 3-C: Objective 3—Distinguish among types of wound healing |
| 12. Hematoma | Module 3-C: Objective 9—Describe factors that present possible complications to the wound-healing process |
| 13. Keloid | Module 3-C: Objective 3—Distinguish among types of wound healing |
| 14. Edema | Module 3-C: Objective 8—Select factors affecting the wound healing process |
| 15. Seroma | |
| 16. Exudates | Module 3-C: Objective 4—Complete statements concerning the phases of first intention wound healing |
| 17. Granulation tissue | Module 3-C: Objective 3—Distinguish among types of wound healing |

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| **B. Definitions (cont.)**<br>18. Contracture<br>19. Gangrene<br>20. Serosanguinous | Module 3-C: Objective 12—Complete statements concerning characteristics of wound disruption |
| **C. Structure and function of the skin** | |
| **D. Types of wounds** | Module 3-C: Objective 2—Distinguish among the basic types of wounds; Assignment Sheet 1—Classify surgical and traumatic wounds |
| 1. Intentional<br>a. Surgical site incision/excision<br>b. Chemical wounds<br>c. Occlusion banding | Module 3-C: Objective 2—Distinguish among the basic types of wounds |
| 2. Unintentional wounds<br>a. Traumatic injuries<br>b. Closed wounds<br>c. Open wounds<br>d. Simple wounds<br>e. Clean wounds<br>f. Complicated wounds<br>g. Delayed full-thickness injury<br>h. Contaminated wounds | Module 3-C: Objective 5—Match classes of traumatic wounds to their correct descriptions; Objective 6—Identify types of traumatic wounds; Assignment Sheet 1—Classify surgical and traumatic wounds; Assignment Sheet 2—Determine types of traumatic wounds |
| 3. Incidental and chronic wounds<br>a. Pressure sores<br>b. Ulcers | Module 3-C: Objective 2—Distinguish among the basic types of wounds |
| **E. Mechanism of wound healing**<br>1. First intention/primary union<br>2. Second intention/granulation<br>3. Third intention/delayed primary closure | Module 3-C: Objective 3—Distinguish among types of wound healing |
| **F. Inflammatory process**<br>1. Pain<br>2. Heat<br>3. Swelling<br>4. Redness | Module 2-C: Objective 15—List the symptoms of acute inflammatory response |
| **G. Healing process**<br>1. Fibrinogen<br>2. Fibroblasts<br>3. Collagen<br>4. Network of fibers<br>5. Scar tissue | Module 3-C: Objective 4—Complete statements concerning the phases of first intention wound healing |
| **H. Stages of wound healing**<br>1. Lag phase/inflammatory response phase<br>2. Proliferation phase<br>3. Maturation or differentiation phase | Module 3-C: Objective 4—Complete statements concerning the phases of first intention wound healing |

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| **I. Factors influencing healing**<br>1. Physical condition<br>a. General health<br>(1) Smoking<br>(2) Circulatory status<br>(3) Age<br>(4) Nutritional status<br>(5) Obesity<br>(6) Inflammatory and immune responses<br>b. Related disease processes<br>(1) Hematology<br>(2) Fluid and electrolyte balance<br>(3) Immunosuppression<br>(4) Drug therapy<br>(5) Radiation<br>(6) Acute/chronic disease process<br>(7) Co-morbidity | Module 3-C: Objective 8—Select factors affecting the wound healing process; Assignment Sheet 3—Distinguish between positive and negative effects on wound healing |
| 2. Surgical technique<br>a. Sterile technique<br>b. Tissue handling<br>c. Methods of hemostasis<br>d. Wound security<br>e. Tissue approximation | Module 3-C: Objective 10—Complete statements concerning the effects of operative technique on wound healing |
| **J. Complications**<br>1. Hematoma/seroma<br>2. Infection<br>3. Wound disruption<br>a. Dehiscence<br>b. Herniation<br>c. Evisceration<br>4. Hemorrhage<br>5. Sinus tract formation<br>6. Fistula<br>7. Scar/surgical cicatrix/keloid<br>8. Adhesion<br>9. Suture complications | Module 3-C: Objective 9—Describe factors that present possible complications to the wound-healing process |

## INFORMATION MANAGEMENT

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| **I. Information sources**<br>A. Library resource center<br>B. World Wide Web<br>C. Databases<br>D. Periodicals<br>E. Books<br>F. CD-ROMs<br>G. Videos<br>H. DVDs<br>I. Manufacturer/industry educational resources | Module 1-A: Assignment Sheet 3—Research professional health care associations and their magazines/journals |

| ETHICAL AND MORAL ISSUES | |
|---|---|
| **I. AHA Patient's Bill of Rights**<br>**A. Tenets**<br>1. The patient is a consumer<br>2. Hospital services are purchased to meet health needs | Module 3-A: Objective 12—Select true statements concerning the Patient's Bill of Rights; Student Supplement 2—The Patient's Bill of Rights |
| **B. Bill of Rights**<br>1. Receive considerate and respectful care<br>2. Obtain from physician complete information concerning diagnosis, treatment, and prognosis in easily understood terms<br>3. Receive from physician information necessary to give informed consent prior to procedure or treatment, including risks, length of incapacitation, and medical alternatives available<br>4. Refuse treatment as allowed by law and be informed of the medical consequences of his/her action<br>5. Receive every consideration of privacy concerning his/her medical program<br>6. Expect that all communications and records are treated as confidential<br>7. Expect that the hospital make a reasonable response to his/her request for services or to be transferred to another medical facility after being informed of the need for the transfer<br>8. Obtain any information of the relationship of his/her hospital to other institutions insofar as his/her care is concerned<br>9. Be advised if the hospital proposes to engage in or perform human experimentation affecting his/her care or treatment, having the right to refuse to participate in such research projects<br>10. Expect reasonable continuity of care, know availability of appointment times and physicians, and be informed by the physician or his/her delegate of continuing health care requirements following discharge<br>11. Examine and receive an explanation of his/her bill regardless of source of payment<br>12. Know what hospital rules and regulations apply to his/her conduct | |

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| **II. Elements of ethical decision making**<br>A. Personal values<br>B. Ethical principles<br>C. Accountability<br>D. Responsibility<br>E. Religious and cultural beliefs<br>F. Morality<br>G. Moral dilemmas<br>H. Corporate integrity<br>I. Ethical decision-making (problem-solving) | Module 3-A: Objective 8—List ways of making ethical decisions as a surgical technologist |
| **III. Surgical conscience**<br>**A. Concepts**<br>1. Professional honesty<br>2. Personal moral integrity<br>3. Confidentiality<br>4. Nondiscriminatory treatment of all patients<br>5. Commitment to cost containment<br>6. Principles of asepsis/sterile technique | Module 3-A: Objective 6—Discuss surgical conscience |
| **B. Barriers**<br>1. Stress<br>2. Peer apathy<br>3. Other | Module 1-A: Student Supplement 1—Student lifestyle considerations; Module 2-A: Objective 4—List causes of stress in the operating room, the impact of stress on the body, and methods of coping with stress; Objective 5—Select true statements concerning psychosocial stress in the patient and within the surgical team |
| **IV. Ethical conflicts in clinical practice**<br>**A. Patient's Bill of Rights**<br>**B. Right-to-die**<br>1. Assisted suicide<br>2. End-of-life decisions<br>**C. Organ donation and transplantation**<br>**D. HIV/AIDS**<br>**E. Genetic engineering**<br>**F. Human experimentation**<br>**G. Abortion and reproductive technology**<br>**H. Good Samaritan Law**<br>**I. Gender reassignment**<br>**J. Refusal of treatment** | Module 3-A: Assignment Sheet 1—Evaluate legal cases involving surgery; Assignment Sheet 2—Evaluate ethical issues involving medicine |

## LEGAL ISSUES

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| **I. Legal terminology**<br>**A. Law**<br>1. Statutory<br>2. Common | Module 3-A: Objective 2—Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions |
| **B. Liability**<br>1. Corporate<br>2. Personal | Module 3-A: Objective 2—Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions |

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| **C. Torts**<br>1. Define<br>2. Intentional<br>a. Civil assault<br>b. Civil battery<br>c. False imprisonment<br>d. Defamation<br>e. Invasion of privacy | Module 3-A: Objective 2—Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions |
| 3. Unintentional<br>a. Negligence<br>(1) Standard/duty of care<br>(2) Dereliction/failure to meet the standard of care<br>(3) Foreseeability of harm existed<br>(4) Omission or commission of an act<br>(5) Actual damages occurred | Module 3-A: Objective 4—Define criteria used to establish negligence in court cases involving the surgical team |
| **D. Malpractice**<br>1. Deposition<br>2. Plaintiff<br>3. Defendant<br>4. Subpoena<br>5. Jury<br>6. Perjury<br>7. Trial | Module 3-A: Objective 1—Discuss accountability for personal actions and obligations |
| **II. Legal doctrines** | |
| **A. Doctrine of Personal Liability**<br>**B. Doctrine of Respondeat Superior**<br>**C. Doctrine of Borrowed Servant**<br>**D. Doctrine of Res Ipsa Loquitur**<br>**E. Doctrine of Foreseeability**<br>**F. Informed Consent**<br>1. "Patient's right to know"<br>2. Preparation of informed consents<br>3. Verification of informed consents<br>4. Legality of informed consents<br>**G. Traditional principles**<br>1. Aeger Primo<br>2. Primum Non Nocere | Module 3-A: Objective 2—Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions |
| **III. Legal risks and responsibilities on the job** | |
| A. Hospital policies<br>B. Legal risks related to reduced staffing<br>C. Witnessing and signing documents<br>D. Legal responsibility for patient safety<br>E. Legal risks related to medications<br>F. Documentation<br>G. Event/incident reports<br>H. Employee rights<br>I. Risk management<br>J. Advance directives | Module 3-A: Objective 1—Discuss accountability for personal actions and obligations; Objective 3—List operating room incidents that could result in litigation |

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| **IV. Professional standards of conduct**<br>A. Federal law<br>B. Federal agencies<br>C. State law and regulations<br>D. Hospital policy<br>E. Legal precedent<br>F. Professional agencies<br>G. AST Code of Ethics<br>H. AST Recommended Standards of Practice<br>I. Core curriculums for surgical technology and surgical assisting<br>J. Private agencies | Module 3-A: Objective 10—List items in the surgical technologist's code of ethics; Objective 11—Complete statements concerning standards of professional practice; Student Supplement 1—The Association of Surgical Technologists (AST) and accrediting agencies for surgical technology |
| **V. Credentialing**<br>A. Registration<br>B. Certification<br>C. Licensure<br>D. Accreditation | Module 3-A: Objective 5—Match terms related to credentialing to their correct definitions |
| **VI. Operating room incidents/sentinel events**<br>A. Harm secondary to use of defective equipment/instruments<br>B. Exceeding authority or accepted functions; violation of hospital policy<br>C. Loss or damage to patient's property<br>D. Abandonment of a patient<br>E. Patient misidentification<br>F. Lack of informed consent<br>G. Documentation errors<br>H. Harm secondary to major break in sterile technique<br>I. Improper identification or loss of specimen<br>J. Burns secondary to improper use of electrosurgical device<br>K. Incorrect drugs or incorrect administration<br>L. Injury related to incorrect positioning or padding<br>M. Falls resulting in patient injury<br>N. Retained foreign bodies secondary to incorrect instrument/sponge counts<br>O. Incorrect procedure performed<br>P. Failure to observe critical events and take appropriate action<br>Q. Invasion of privacy<br>R. Assault and battery<br>S. Defamation<br>T. Breach of confidentiality | Module 3-A: Objective 3—List operating room incidents that could result in litigation |

| PROFESSIONAL CREDENTIALING | |
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| **I. Credentialing**<br>**A. Functions**<br>1. Establishes professional and national performance standards<br>2. Provides accountability<br>3. Recognition of the profession<br>4. Mode of occupational regulation<br>5. Establishes initial and continuing competence<br>6. Protects and promotes the public's health | Module 3-A: Objective 5—Match terms related to credentialing to their correct definitions |
| **II. Certification**<br>**A. Qualifiers**<br>1. Voluntary<br>2. Benefits and limitations<br>a. Strengthens profession<br>b. Assures standards of competency and practice<br>c. Links candidacy for certification to graduation from accredited program<br>d. Should be required as a condition of employment | Module 3-A: Objective 5—Match terms related to credentialing to their correct definitions |
| **III. Registration**<br>**A. Required by a state agency**<br>**B. Mandatory—enforcement by state agency**<br>**C. May be enforced with or without requiring minimum standards or testing**<br>**D. Benefits and limitations**<br>1. Restricts unqualified practitioners<br>2. Limits scope of practice<br>3. Establishes minimum standards | Module 3-A: Objective 5—Match terms related to credentialing to their correct definitions |
| **IV. Licensure**<br>**A. Most restrictive form of occupational regulation**<br>**B. Controlled by the state government**<br>**C. Requires standards of practice, education, minimum competency, and inspection/enforcement**<br>**D. Benefits and limitations**<br>1. Standards of practice<br>2. Education requirements<br>3. Minimum competency<br>4. Civil/criminal penalties | Module 3-A: Objective 5—Match terms related to credentialing to their correct definitions |
| **V. Continuing education**<br>**A. Purpose**<br>1. Maintain currency<br>2. Expand knowledge base<br>3. Learn about technology advancements | Module 1-A: Teacher Supplement 2—Becoming a Certified Surgical Technologist (CST) |

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| **V. Continuing education (cont.)**<br>**B. Types**<br>1. Hospital in-service<br>2. National conference/specialty forums<br>3. State and local workshops<br>4. Academic courses<br>5. Journals/home study<br>6. Industry specific | Module 1-A: Teacher Supplement 2—Becoming a Certified Surgical Technologist (CST) |
| **PROFESSIONAL ORGANIZATIONS** | |
| **I. Professional organizations and credentialing**<br>**A. Commission on Accreditation of Allied Health Education Programs (CAAHEP)**<br>**B. Accreditation Review committee on Education in Surgical Technology**<br>**C. Association of Surgical Technologists (AST)**<br>1. Historical background<br>2. Goals<br>3. Purpose<br>4. Membership composition<br>5. Committees<br>6. Meetings<br>7. Annual national conference<br>8. Workshops and forums<br>9. Professional liability insurance<br>**D. Credentialing organization** | Module 3-A: Student Supplement 1—The Association of Surgical Technologists (AST) and accrediting agencies for surgical technology |
| **E. Related professional organizations**<br>1. Joint Commission on Accreditation of Healthcare Organizations (JCAHO)<br>2. American College of Surgeons (ACS)<br>3. Association of periOperative Registered Nurses (AORN)<br>4. Association for the Advancement of Medical Instrumentation (AAMI)<br>5. National Institute of Occupational Safety and Health (NIOSH)<br>6. Occupational Safety and Health Administration (OSHA)<br>7. American National Standards Institute (ANSI)<br>8. American Hospital Association (AHA)<br>9. American Medical Association (AMA)<br>10. Center for Disease Control (CDC)<br>11. Food and Drug Administration (FDA)<br>12. National Fire Protection Association (NFPA)<br>13. World Health Organization (WHO) | Module 1-A: Assignment Sheet 4—Research organizations that provide health care support |

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| **II. Healthcare agencies**<br>**A. Health insurance**<br>1. Medicare<br>2. Medicaid<br>3. Private<br>4. Health maintenance organizations (HMOs)<br>5. Preferred provider organizations (PPOs)<br>**B. Prospective payment systems**<br>1. Diagnosis-related groups (DRGs)<br>2. Other methods<br>3. Impact<br>**C. Governmental organizations**<br>1. HCFA<br>2. OSHA<br>3. CDC<br>4. Other<br>**D. Private volunteer agencies** | Module 1-A: Teacher Supplement 1—Health care organizations and funding |
| **III. Professionalism**<br>A. Membership in the Association of Surgical Technologists (AST)<br>B. Certification<br>C. Continuing education<br>D. Community service<br>E. Role model<br>F. Ethical behavior | Module 1-A: Teacher Supplement 2—Becoming a Certified Surgical Technologist (CST) |
| **LEADERSHIP** | |
| **I. Communication**<br>**A. Body language** | Module 2-A: Student Supplement 2—Body language |
| **B. Barriers to effective communication**<br>1. Prejudice<br>2. Emotion<br>3. Lack of knowledge<br>4. Personality<br>5. Perception | Module 2-A: Objective 15—Match blocks to therapeutic communication to their correct examples. |
| **C. Basic communication skills**<br>1. Parts of communication<br>a. Sending the message<br>b. Listening<br>c. Interpreting | Module 2-A: Objective 9—List essential components of effective communication |
| 2. Types of communication<br>a. Verbal<br>(1) Concepts<br>(2) Components<br>b. Nonverbal<br>(1) Concepts<br>(2) Components | Module 2-A: Objective 7—Match means of communication to their correct descriptions; Student Supplement 2—Body language |

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| **C. Basic communication skills (cont.)** | |
| 3. Effective communication techniques | Module 2-A: Objective 10—List effective listening skills utilizing components of communication; Objective 11—Describe effective speaking skills; Assignment Sheet 3—Apply effective communication skills in given situations |
| 4. Ineffective communication techniques | Module 2-A: Assignment Sheet 3—Apply effective communication skills in given situations |
| 5. Block to effective communication | Module 2-A: Objective 15—Match blocks to therapeutic communication to their correct examples |
| **II. Leadership** | |
| **A. Leadership skills** | |
| **B. Types** | |
| 1. Formal leaders | |
| a. Team leaders | |
| b. Supervisors | |
| 2. Informal leaders | |
| **C. Leadership styles** | |
| 1. Autocratic | |
| 2. Bureaucratic | |
| 3. Democratic | |
| 4. Laissez-faire | |
| 5. Transformational | |
| **D. Motivation** | |
| 1. Principles | |
| 2. Theories | |
| a. Maslow's Hierarchy of Needs Theory | Module 2-A: Objective 3—Arrange in order Maslow's hierarchy of human needs |
| **E. Precepting and training** | |
| 1. Principles | |
| 2. Problem resolution | |

## AFFECTIVE BEHAVIORS

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| **I. Professional behaviors** | Module 1-A: Student Supplement 2—Desirable traits and special demands of the surgical technologist |
| A. Surgical conscience | |
| B. Autonomy | |
| C. Critical thinking | |
| D. Prioritization | |
| E. Discrimination | |
| F. Motivation | |
| G. Commitment | |
| H. Flexibility | |
| I. Adaptability | |
| J. Self-direction | |
| K. Internalization | |
| L. Work ethic | |
| M. Anticipation | |

| EMPLOYABILITY SKILLS | |
|---|---|
| **I. Employment in the healthcare field**<br>A. Career information<br>B. Current employment trends and opportunities<br>C. Employment facilities and institutions<br>D. Transition from student to employee | Module 1-A: Student Supplement 4—How to get a job and keep it |
| **II. Employability qualities**<br>A. Strong work ethic<br>B. Ambition<br>C. Communication skills (verbal and written)<br>D. Motivation/initiative<br>E. Honesty/integrity<br>F. Dedication<br>G. Flexibility/adaptability<br>H. Conflict resolution<br>I. Attendance and punctuality<br>J. Personal appearance<br>K. Commitment<br>L. Dependability<br>M. Competencies/skills<br>N. Interpersonal skills<br>O. Conscientiousness<br>P. Understanding of policies/procedures<br>Q. Team mentality<br>R. Accountability<br>S. Willingness to serve on committees<br>T. Commitment to continuing education<br>U. Spirit of cooperation<br>V. Moral and legal obligations | Module 1-A: Student Supplement 4—How to get a job and keep it |
| **III. Résumé preparation**<br>**A. Elements**<br>1. Purpose<br>2. Presentation style<br>3. List qualifications<br>4. Organized and neat<br>5. Correct spelling, grammar, etc.<br>6. Typed<br>7. Length<br>8. Electronic versus paper<br>**B. Content**<br>1. Identification (name/address)<br>2. Career objective<br>3. Education<br>4. Work experience<br>5. Outside activities and interests<br>6. Achievements/honors<br>7. References available | Module 1-A: Student Supplement 4—How to get a job and keep it |

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| **IV. Application correspondence**<br>**A. Cover letter**<br>1. Position desired<br>2. Education and experience summary<br>3. Suggested contact and availability<br>**B. Professional reference letter**<br>1. Permission<br>2. Factual information<br>**C. Thank you letter/appreciation**<br>1. Expresses appreciation for the interview<br>2. Reemphasizes strongest qualifications<br>3. Reiterates interest in the position<br>**D. Acceptance letter**<br>1. Acceptance of the position<br>2. Confirms starting date and time<br>**E. Letter of refusal**<br>1. Refuse a position<br>2. Thanks individuals involved in interview process | Module 1-A: Student Supplement 4—How to get a job and keep it |
| **V. Employment application form**<br>A. Read employment application form first<br>B. Neat<br>C. Accurate<br>D. Follow instructions<br>E. Dates of education and work experience<br>F. Reference information available | Module 1-A: Student Supplement 4—How to get a job and keep it |
| **VI. Interview strategies**<br>A. Prepare prior to interview<br>1. Consult career books<br>2. Seek out experts<br>3. Gather information about the position and organization<br>4. Prepare questions<br>5. Rehearse<br>B. Appropriate attire<br>C. Be punctual<br>D. Be prepared<br>E. Introduce yourself<br>F. Demonstrate confidence<br>G. Project a positive image<br>H. Make only positive or neutral comments<br>I. Close the interview on a positive note<br>J. Thank individuals involved in interview process | Module 1-A: Student Supplement 4—How to get a job and keep it |
| **VII. Resignation**<br>A. Notice<br>1. Written<br>2. Verbal<br>B. Exit interview | |

## RISK MANAGEMENT AND LIABILITY

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| **I. Risk management objectives**<br>A. Minimize risks to patients and hospital employees<br>B. Avoid or control financial loss<br>C. Identify actual or potential causes of patient and employee accidents<br>D. Implement programs, policies, and procedures to eliminate or reduce occurrences<br>E. Efforts of hospital to collect and utilize data to decrease harm to patients and staff or damage to property | |
| **II. Errors in the operating room**<br>A. Physician error<br>B. Failure of equipment or medical device (Safe Medical Devices Act)<br>C. Errors made by surgical team members | |
| **III. Administrative practice**<br>A. Written policies and procedures<br>B. Regulations, laws, recommendations enforced<br>C. Monitoring devices used in hazardous areas as recommended by regulatory agencies<br>D. Employee health services<br>E. Protective attire and safety equipment (standard precautions) | Module 2-B: Objective 26—Complete statements concerning Standard Precautions |
| **IV. Prevention practices**<br>A. Routine preventative maintenance for all equipment<br>B. Professional development/continuing education programs for employees<br>C. Employees must wear personal protective equipment, as appropriate (standard precautions)<br>D. Employees must know the location and use of emergency equipment<br>E. Employees must follow hospital policies and procedures<br>F. Continuity of patient care and safety | Module 1-B: Objective 24—Select true statements concerning basic equipment safety; Assignment Sheet 6—Apply safety principles to the school and workplace |
| **V. Interventions**<br>A. Unsafe conditions reported immediately<br>B. Faulty or malfunctioning equipment or device should be removed from service immediately<br>C. Any patient or employee injury should be reported and medical attention sought as soon as possible<br>D. Proper documentation of incident | Module 1-B: Objective 3—List general steps/guidelines for reporting defective equipment; Assignment Sheet 6—Apply safety principles to the school and workplace;<br>Module 2-B: Teacher Supplement 4—Emergency management |

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| **VI. Documentation**<br>A. Incident Report/Sentinel Event Report<br>B. Occupational risks communicated to employees<br>C. Witnesses<br>D. Document facts not opinions | Module 1-B: Assignment Sheet 2—Complete an accident report form; Module 2-B: Teacher Supplement 1—OSHA workplace violence checklist; Teacher Supplement 2—Sample OSHA violence incident report form |
| **VII. Insurance**<br>A. Hospital insurance coverage (liability)<br>B. Malpractice insurance (professional liability)<br>C. Amount of coverage/cost of coverage<br>D. Extent of insurance coverage provision | Module 1-A: Teacher Supplement 1—Health care organizations and funding |

**HOSPITAL ORGANIZATION AND MANAGEMENT**

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| **I. Team members**<br>A. Surgical Technologist<br>B. Registered Nurse<br>C. Surgeon<br>1. Medical Doctor (MD)<br>2. Doctor of Osteopathy (DO)<br>3. Doctor of Dental Science/Doctor of Dental Medicine (DDS/DMD)<br>4. Podiatrist (DPM)<br>D. Assistants<br>1. Residents/interns/medical students<br>2. Surgical Assistant (SA)<br>3. Surgical Technologist (ST)<br>4. Registered Nurse First Assistant (RNFA)<br>5. Physician Assistant (PA)<br>E. Anesthesia provider<br>1. Anesthesiologist (MD/DO)<br>2. Nurse Anesthetist (CRNA)<br>F. Support personnel<br>1. Anesthesia Technologist<br>2. Aides/orderly<br>3. Secretary<br>4. Equipment technicians<br>a. X-ray/fluoroscopy<br>b. EEG | Module 1-A: Objective 8—List the members of the surgical team; Objective 10—Match surgical team members to their functions; Assignment Sheet 2—Distinguish among duties of the surgical team members |
| **II. Roles in the operating room**<br>A. Surgical technologist in the scrub role<br>B. Circulator<br>C. Surgeon<br>D. Assistant<br>E. Anesthesia provider<br>F. Support personnel | Module 1-A: Objective 8—List the members of the surgical team; Objective 9—Distinguish between sterile and unsterile surgical team members; Objective 10—Match surgical team members to their functions; Assignment Sheet 2—Distinguish among duties of the surgical team members |
| **III. Chain of command**<br>A. Area/shift manager<br>B. Department manager<br>C. Perioperative services director<br>D. Vice president<br>E. President/CEO<br>F. Board of Directors/trustees | Module 1-A: Objective 5—Describe a typical hospital organizational chart; Objective 6—Describe a typical hospital organizational structure for surgical services |

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| **IV. Related hospital departments**<br>**A. Direct patient care**<br>1. Nursing care units<br>2. Diagnostic imaging<br>3. Blood bank<br>4. Pathology<br>5. Clinical laboratories<br>6. Pharmacy | Module 1-A: Objective 7—List hospital departments on which the surgical suite depends to give continuity of patient care |
| **B. Indirect patient care**<br>1. Housekeeping<br>2. Maintenance<br>3. Central supply<br>4. Food and nutritional services<br>5. Biomedical engineering | Module 1-A: Objective 7—List hospital departments on which the surgical suite depends to give continuity of patient care |
| **SCOPE OF PRACTICE** | |
| **I. Description of the profession**<br>**A. Definition** | Module 1-A: Objective 13—Define and state the purpose of a job description for a surgical technologist |
| **B. Components of the job description**<br>1. Job title<br>2. Entry criteria<br>3. Nature of the position<br>a. Able to stand, bend, stoop, and/or sit for long periods of time in one location with minimum/no breaks<br>b. Able to lift a minimum of 20 pounds<br>c. Able to refrain from nourishment or restroom breaks for periods up to 6 hours<br>d. Demonstrate sufficient visual ability enough to load a fine (10–0) suture onto needles and needleholders with/without corrective lenses and while wearing safety glasses<br>e. Demonstrate sufficient peripheral vision to anticipate and function while in the sterile surgical environment<br>f. Hear and understand muffled communication without visualization of the communicator's mouth/lips and within 20 feet<br>g. Hear activation/warning signals on equipment<br>h. Able to detect odors sufficient to maintain environmental safety and patient needs<br>i. Manipulate instruments, supplies and equipment with speed, dexterity, and good eye-hand coordination<br>j. Ambulate/move around without assistive devices<br>k. Able to assist with and/or lift, move, position, and manipulate the patient who is unconscious with or without assistive devices | Module 1-A: Student Supplement 2—Desirable traits and special demands of the surgical technologist |

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| **B. Components of the job description (cont.)**<br>l. Communicate & understand fluent English both verbally and in writing<br>m. To be free of reportable communicable diseases & chemical abuse<br>n. Able to demonstrate immunity (natural or artificial) to Rubella, Rubeola, Tuberculosis, and Hepatitis B, or be vaccinated against these diseases, or willing to sign a waiver of release of liability regarding these diseases<br>o. Possess short- & long-term memory sufficient to perform tasks such as, but not limited to, mentally tracking surgical supplies and performing anticipation skills intraoperatively<br>p. Able to make appropriate judgment decisions<br>q. Demonstrate the use of positive coping skills under stress<br>r. Demonstrate calm and effective responses, especially in emergency situations<br>s. Exhibit positive interpersonal skills during patient, staff, and faculty interactions<br>4. Duties<br>5. Accountability<br>6. Supervision | Module 1-A: Student Supplement 2—Desirable traits and special demands of the surgical technologist |
| **II. Roles and competencies**<br>**A. Career development**<br>**B. Requirements**<br>1. Responsibilities of the surgical technologist in the scrub role<br>a. Preoperative<br>(1) Don operating room attire and personal protective equipment<br>(2) Prepare the OR<br>(3) Gather/check necessary instrumentation, equipment and supplies<br>(4) Create and maintain the sterile field<br>(5) Perform surgical scrub<br>(6) Don sterile gown and gloves<br>(7) Organize the sterile field for use<br>(8) Counts necessary items with circulator<br>(9) Assist team members during entry of the sterile field<br>(10) Expose the operative site with sterile drapes | Module 1-A: Objective 14—Select job responsibilities and functions of the scrub role; Assignment Sheet 2—Distinguish among duties of the surgical team members |

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| **B. Requirements (cont.)**<br>b. Intraoperative<br>(1) Maintains highest standard of sterile technique during the procedure<br>(2) Maintains the sterile field<br>(3) Pass instrumentation, equipment & supplies to the surgeon & surgical assistant as needed<br>(4) Assess & predict (anticipate) the needs of the patient & surgeon and provide the necessary items in order of need<br>(5) Medication preparation and handling<br>(6) Count necessary items<br>(7) Specimen care<br>(8) Assists with other intraoperative tasks<br>(9) Prepares and applies sterile dressings<br>c. Postoperative<br>(1) Assists surgical team with patient care, when needed<br>(2) Prepares instruments for terminal sterilization<br>(3) Assists other members of the team with terminal cleaning of the surgical suite | Module 1-A: Objective 14—Select job responsibilities and functions of the scrub role; Assignment Sheet 2—Distinguish among duties of the surgical team members |
| 2. Responsibilities of the surgical technologist in the circulating role<br>a. Preoperative<br>(1) Obtains appropriate sterile and nonsterile items needed for the surgical procedure<br>(2) Opens sterile instruments, supplies, and equipment<br>(3) Checks patient's chart, identifies patient, verifies surgery to be performed with consent form<br>(4) Transfers patient to operating room table<br>(5) Provide comfort and safety measures<br>(6) Provide verbal and tactile reassurance to the patient<br>(7) Assists anesthesia personnel<br>(8) Positions the patient, using appropriate equipment and safety measures<br>(9) Applies electrosurgical grounding pads, tourniquets, and monitors on the patient, using appropriate safety measures<br>(10) Performs preoperative skin preparation<br>(11) Performs counts | Module 1-A: Objective 15—Select job responsibilities and functions of the circulator; Assignment Sheet 2—Distinguish among duties of the surgical team members |

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| **B. Requirements (cont.)**<br>2. Responsibilities of the surgical technologist in the circulating role (cont.)<br>b. Intraoperative<br>(1) Positions and operates equipment needed for the procedure<br>(2) Anticipates additional supplies needed during the procedure<br>(3) Facilitates communication between sterile and nonsterile areas<br>(4) Records accurate documentation throughout the procedure<br>(5) Cares for specimens<br>(6) Secures dressings after incision closure<br>c. Postoperative<br>(1) Helps transport patient to recovery room<br>(2) Assists in terminal cleaning of the surgical suite<br>(3) Prepares for the next patient | Module 1-A: Objective 15—Select job responsibilities and functions of the circulator; Assignment Sheet 2—Distinguish among duties of the surgical team members |
| **C. Related career opportunities**<br>1. Central sterile manager<br>2. Educator<br>3. Surgical assistant<br>4. Materials manager<br>5. Medical salesperson<br>6. Organ and tissue procurement/preservation technician<br>7. Physician/surgeon's assistant<br>8. Research assistant<br>9. Veterinary assistant<br>10. Labor and delivery staff<br>11. Office manager<br>12. Surgery scheduler<br>13. Anesthesia technologist<br>14. Self-employed<br>15. Other | Module 1-A: Objective 11—List areas of employment for the surgical technologist |

# Introduction to Surgical Technology

## SECTION A:
## Orientation to Surgical Technology

### Module 1-A: Professional Responsibilities and Relations

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Review teacher supplements and make copies of any that will be provided for each student.
- Make transparencies from the transparency masters.
- Review the Optional Assignment Sheet and make copies as needed.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.
- Give and evaluate the posttest.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module has two primary purposes: to introduce students to the organizational structure of hospitals and out-patient surgical centers; and to help students understand their role as a member of the surgical team.

- Using Student Supplement 1, discuss with students the challenges they will face as they pursue their education to become a certified surgical technologist.
- Discuss team spirit and its relationship to the operating room team members. This activity will emphasize group effectiveness and interpersonal relations.
- Use Transparency Master 1 to discuss with students a typical organizational chart for a medical facility. Ask local health care facilities to provide copies of their organizational charts to share with students.
- Discuss the health care system and funding for patient care. Refer to Teacher Supplement 1 to assist you in your presentation.
- Use Transparency Master 2 to discuss the organizational structure of an OR suite.
- Make arrangements for students to tour a local hospital to learn more about the organizational structure of the facility and to view a surgical suite.
- Discuss the physical and emotional requirements of a career as a surgical technologist. Discussions such as these can reinforce the students' understanding of the surgical technology profession, develop personal management skills, and increase their motivation to learn more about the profession. Refer to Student Supplement 2.

- Invite a member of the local AST chapter to discuss professionalism and the benefits of belonging to the organization. Have students refer to Student Supplement 3 and discuss with them ways to promote professionalism. As part of this discussion, have presenter discuss the need for malpractice insurance and the recommendation of AST for surgical technologists to be covered. Note that AST offers malpractice insurance to its members.

- Discuss the Association of Surgical Technologists (AST) and the accrediting agencies and the procedure and process for becoming certified (how, when, why). Refer to Teacher Supplement 2. Also mention related professional organizations including the Association of Operating Room Nurses (AORN) and the American College of Surgeons (ACS) and their support in raising healthcare standards.

- Provide an example of a job description for a surgical technologist, and have students discuss the requirements. If possible, have a surgical technologist visit with students about experiences as a surgical technologist and to emphasize skills needed to be successful in the profession.

- When students are ready to apply for a job, have them study Student Supplement 4 and discuss with them the steps in the hiring process. To assist students in developing their interview skills, hold practice interviews using the interview guide provided in Teacher Supplement 3.

  ✔ **NOTE:** If you have a resource center and staff qualified to assist students in preparing their résumé and other written correspondence, please make arrangements with them to meet with the class.

- Discuss with students the benefits of preparing a career portfolio. Refer to Teacher Supplement 1 and Optional Assignment Sheet 1 if you would like your students to prepare a career portfolio as part of their class activities.

**RESOURCES USED IN DEVELOPING THIS MODULE**

**Books**

- Caruthers, Bob L., and Paul Price, ed. *Surgical Technology for the Surgical Technologist—A Positive Care Approach*. Albany, NY: Delmar, 2001.
- Fortunato, Nancymarie. *Berry and Kohn's Operating Room Technique*. 9th ed. St. Louis: Mosby, Inc., 2000.
- Fuller, Joanna R. *Surgical Technology—Principles and Practice*. 3rd ed. Philadelphia: W. B. Saunders Co., 1994.
- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1994.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery*. 11th ed. St. Louis: Mosby, Inc., 1999.
- *Practical Nursing Series—Nursing Concepts*. Stillwater, OK: Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1998.
- Smeltzer, Suzanne C., and Brenda G. Bare. *Brunner and Suddarth's Textbook of Medical-Surgical Nursing*. 9th ed. Philadelphia: Lippincott Williams & Wilkins Publishers, 2000.

**Pamphlets**

- *Competency Statements for the Surgical Technologist*. Littleton, CO: Association of Surgical Technologists, Inc.
- *Developing the Career Portfolio*. Tulsa, OK: Tulsa Technology Center.
- *An Introduction to the Association of Surgical Technologists*. Littleton, CO: Association of Surgical Technologists, Inc.
- *Interview Guide and Handout*. Tulsa, OK: Tulsa Technology Center.
- *Job Description: Certified Surgical Technologist*. Littleton, CO: Association of Surgical Technologists, Inc.
- *A Profile of the Surgical Technologist*. Littleton, CO: Association of Surgical Technologists, Inc.
- *Surgical Technologist and First Assistant National Certifying Examinations—Candidate Handbook*. Englewood, CO: Liaison Council on Certification for the Surgical Technologist (LCC-ST), 1999.

**Magazine Articles**

- Kircher, Edwin L. "Survival Tactics for Surgical Technologists." *Student Connection* (Spring 1999): 2-3.
- Netzel, Lizabeth. "The Meaning of Certification—Then and Now." *The Surgical Technologist* (December 1995): 25-27.

**Web Sites**

- www.bassberry.com/resources/corp/030098/main.html

  *Emerging Trends in Non-Profit and For-Profit Hospital Mergers, Acquisitions, and Joint Ventures*. Retrieved December 19, 2001, from Bass, Berry & Sims PLC.

- www.ast.org

  Association of Surgical Technologists, Inc.

**SUGGESTED SUPPLEMENTAL RESOURCES**

- *This is Perioperative Nursing*. 1991. 15-minute videotape highlights the daily activities within the operating room.

  Available from:

  Ciné-Med, Inc.
  127 Main Street North
  Woodbury, CT 06798
  800-253-7657
  www.cine-med.com

**SUGGESTED WEB SITES***

- http://www.ast.org

  The Association of Surgical Technologists' Web site contains information on surgical team members, the profession of surgical technology, education and standards, as well as other information related to surgical technology.

- http://www.aorn.org

  AORN Online is the Web site of The Association of Operating Room Nurses. This site contains information on clinical practice, education, government affairs, and research related to operating room nurses.

- http://www.CAAHEP.org

  This is the Web site of the Commission on Accreditation of Allied Health Education Programs (CAAHEP). CAAHEP is the accrediting body for surgical technology programs and is the umbrella organization for the surgical technology committee on accreditation, which is the ARC-ST.

- http://www.arcst.org

  This is the Web site of the Accreditation Review Committee on education in Surgical Technology (ARC-ST).

- http://stats.bls.gov/oco/ocos106.htm

  The Occupational Outlook Handbook Web site provides a description of the nature of work, working environment, employment, training, job outlook, and earnings of a surgical technologist.

- http://careerplanning.about.com/

  About.com's Career Planning Web site contains information on writing résumés, choosing a career, searching for a job, and writing cover letters and follow-up letters.

- http://www.learn2.com

  This Web site contains step-by-step instructions on how to write a résumé and cover letter and how to prepare for a job interview.

- http://www.resumania.com

  This Web site presents clever examples of how not to write a résumé.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

# Teacher Supplement 1—Health Care Organizations and Funding

✔ **NOTE:** Parts of this supplement have been adapted from the CIMC module "Concepts of Health Care Economics."

STRATEGY 1 **Discuss the various methods of covering health care costs.**

Who really pays for the health care Americans receive? The answer used to be "insurance companies." Now health maintenance organizations, preferred provider organizations, and other types of employer groups are a major source of health care payment. Medicare and Medicaid are the main sources of payment for people who qualify for these programs. How does this type of payment impact the care you give? Who decides what is medically necessary? In this supplement you will learn the answers to these and other questions about the economics of health care.

The cost of health care in the United States is astronomical. Many changes have occurred in the health insurance industry in an effort to contain health care costs. This effort has had both positive and negative outcomes. Health care costs are paid in three major ways.

- The employer pays all or part of the insurance premium as a benefit for an employee, and employees may purchase insurance for other family members. This insurance may be in the form of **indemnity insurance**, a **health maintenance organization** (HMO), or a **preferred provider organization** (PPO).

KEY TERMS

**Indemnity insurance**—Type of insurance coverage with few controls regarding accessing care; the insured person pays premiums and an annual deductible amount

**Health maintenance organization**—Type of health insurance coverage with a primary care physician as the gatekeeper to other types of medical care; the insured person pays a monthly premium and a co-pay when accessing care

**Preferred provider organization**—Type of health insurance coverage with controls over which health care providers can be accessed by the insured; the insured person pays a monthly premium and a co-pay when accessing care

- The federal or state government pays part or all of the insurance premium through "entitlement" programs. Persons receiving such benefits must complete and file the correct paperwork. The amounts these programs will pay are limited.
  - **Medicare** is a federal government program that pays for health care for people age 65 and over and for younger people who are disabled.
  - **Medicaid** is a state government program that pays for health care for people making less than a specified income and for the indigent.

- People without insurance and who are ineligible for entitlements pay for medical costs themselves. More people are in this category as the job market shifts to part-time workers, self-employed workers, contract labor, and to positions without benefits.

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**Optional Learning Activity**

Have students find out more about issues surrounding different aspects of health care funding.

Instructions: Find an article about one aspect of health care funding such as HMOs, employer paid premiums, Medicare, or Medicaid. Read the article and write a two to three paragraph summary of its content. Share your summary with the class or group as assigned by your instructor.

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STRATEGY 2

**Explain the effect that a prospective payment system has on the health care delivery system.**

To understand health care funding today, you must understand the evolution of health care funding over the past several decades. Before 1980, the primary type of payment for health care was through indemnity insurance. This kind of insurance allowed the patient to access any health care provider, including specialists, with few limitations on the amount of health care provided. Surgeries, procedures, and tests were done if any doctor deemed them necessary. Unfortunately, many unnecessary costly examinations and tests were run to rule out all possible causes of a symptom. Emergency room visits were made without questioning whether the situation was truly an emergency.

For this care, the insured person usually paid a monthly premium plus a yearly deductible ranging from $100 to $1000. In addition, the insured paid 20 to 30% of the costs of doctor visits, tests, surgeries, and procedures. The insurance company paid the rest of the costs of medical care for the insured. Few, if any, controls existed over what a doctor or facility could charge for services, and as a result, costs continued to increase every year.

One of the first attempts to control health care costs came in the early 1980s in the form of Diagnostic Related Groups (DRGs). This is a cost-reimbursement plan that classifies patients according to age, diagnosis, and surgical procedure. Over 300 categories are used to predict the use of hospital resources and the length of stay in the hospital. Initially, government programs (Medicare and Medicaid) used these guidelines for payment to the hospital. If the patient had to stay longer or needed more care, the hospital was not reimbursed for the extra cost. Other patients stayed fewer days or required less care, but the hospital still received the same amount of money for each patient's care. Private insurance began using DRG guidelines as well.

Then came managed care as a way to control escalating health care costs while still providing medical care. The big change in thinking with managed care was that the patient was no longer directing his or her own health care. Instead, HMOs put selected doctors in the role.

Every member of an HMO selects a primary care physician (PCP) from a list of participating doctors. All health care management decisions are made by this physician, and members must go to their PCP for all care. As a result, specialized care can only be accessed by a referral from the PCP. Members referred to specialists are sent to those on the HMO's list of participating doctors.

Members who have an elective surgery or planned hospital stay must obtain the prior approval of the HMO. A member admitted to the hospital due to an emergency generally must notify the HMO within a specific time frame, generally within 24 hours of admission.

In addition to a monthly premium, HMO members pay a co-pay for doctor's visits and prescriptions. These charges vary greatly and may range from $10 to $50. On the other hand, HMO members pay no yearly deductible and do not have to file any insurance forms. The "out-of-pocket" expense is less than indemnity insurance, but patients have fewer choices about their care.

The reason for seeing a "primary care physician" and providing members with a participating doctor's list is to control costs. The PCP is paid a certain amount of money per member per month to manage the care of all patients who chose that physician as their PCP. This is called the ***capitation fee***. If costs go higher than the allotted amount, the physician does not make money. If the costs are lower, the physician and the HMO do make money. Specialists contract to be paid for each patient seen, but at a lower cost than they would normally charge. Laboratories, X-ray facilities, hospitals, and other services may be capitated as well. A dollar amount is set aside for hospital stays, emergency room use, and referrals to specialists. In some HMOs, doctors are given bonuses to limit spending for those services.

KEY TERM

**Capitation fee**—Amount of money paid to a physician per member per month to manage the health care of all patients who chose that physician as their primary care physician

PPOs are similar to HMOs but with some significant differences. Patients have more choices in accessing health care but must still choose providers from a preferred provider list. If patients go to a physician not on the list, the PPO will not pay for costs incurred. The patients are solely responsible for those costs. The monthly premiums and co-pay amounts of a PPO are higher than those of an HMO.

**STRATEGY 3**

**Discuss the impact of health care corporations on rural and local hospitals.**

One of the biggest changes that has impacted health care is the purchase of rural and smaller metropolitan hospitals by larger health care corporations. An example at the national level is Columbia Healthcare which has bought hospitals in a number of states to develop a national health care network. In addition, health care corporations own health maintenance organizations (HMOs), clinics, laboratories, home health agencies, and other facilities.

Many local hospitals must form partnerships with larger networks or market themselves with a specialty edge to remain independent from the larger health care conglomerates. It is a difficult task to compete with the marketing money available to the larger corporations.

**STRATEGY 4**

**Discuss which health care facility provides better health care—the For-Profit or Non-Profit Hospital.**

✔ **NOTE:** The following information is an excerpt from "Emerging Trends in Non-Profit and For-Profit Hospital Mergers, Acquisitions, and Joint Ventures," a presentation at the August 3, 1998, American Bar Association Annual Meeting in Toronto, Canada.

Trade associations for both the for-profit hospital and the not-for-profit hospital industries have released reports on the impact of hospital purchases by for-profit companies. In one survey conducted by the Federation of American Health Systems, the association representing for-profit hospitals, researchers found that when for-profit chains acquire non-profit hospitals, the facilities' finances improve and there is no reduction in the amount of charity care. Another study by VHA, Inc., an association of approximately 900 non-profit hospitals, found that non-profit hospitals spend more on patient care and have lower charges than investor-owned facilities in the same Florida market.

To further complicate the issue, a study conducted in March 1998 by the Kaiser Family Foundation found that 42% of respondents said the trend toward for-profit ownership is a "bad thing" for health care compared with 20% who said it was good. In those surveyed, 53% responded that they felt positive about the phrase "non-profit healthcare," while 34% felt positive about "for-profit healthcare."

## Teacher Supplement 2—Becoming a Certified Surgical Technologist (CST)

### Steps in Becoming Certified

It is essential that students obtain a copy of Candidate Handbook for Certification from the Liaison Council on Certification for the Surgical Technologist (LCC-ST). (Visit www.lcc-st.org for more information.) Students who have completed a certified surgical technology program should have little trouble meeting the eligibility requirements.

The first step is to submit the Application for Eligibility Review Form to the LCC-ST (included in the Handbook). There is a fee for this review. The applicant will be notified whether or not he/she meets the basic requirements and will be provided with test dates, times, location, and phone number of the testing agency. A student will need to schedule the date with an agency representative.

The actual test consists of 250 multiple choice questions across a broad spectrum of patient care, aseptic technique, and surgical procedures. It is administered on an electronic testing device that allows you to receive notification of your pass/fail status within minutes of completion.

The LCC-ST publishes a practice test, and AST publishes a study guide that can help students anticipate the knowledge requirements and types of material they can expect on the test.

Certification is good for six years. Recertification can be accomplished by meeting a number of continuing education credits or students can retake the certifying examination.

### Recertification and Career Advancement Through Continuing Education and Lifelong Learning

One of the best ways for surgical technologists to advance their career is to show a commitment to continuing education. AST and other organizations offer dozens of opportunities to learn new techniques, new technology, and advances in the health care profession. Seminars, conferences, and other courses provide surgical technologists with education credits that can help them meet CST recertification requirements. Any time you participate in these educational opportunities, you should obtain evidence of the classes you take, and number of credits you are entitled to. Educational materials should be saved for future reference.

Recording and processing the continuing education credits is a benefit of belonging to the professional organization—AST (Association of Surgical Technologists). For more information, go to their Web site: www.ast.org

Another great way to keep current and learn new techniques to advance your career is by reading health care professional journals/magazines. Membership in AST includes a subscription to *The Surgical Technologist*. This publication provides information on the latest techniques and technology, continuing education opportunities, national employment opportunities, and other information about the profession. There are several other professional journals that can also provide related information. See Assignment Sheet 3 in the student edition.

## Teacher Supplement 3—Interview Guide for Surgical Technologist Position

This interview guide has been provided to assist students in practicing their interview skills. The questions are based on an interview technique called "Targeted Selection," and are categorized by target dimensions that represent the knowledge, skills, or behavior an applicant should possess to be successful. Based on those dimensions, questions have been selected that will help the interviewer collect the information that is needed to make an objective decision about the applicant.

Discuss with students how interviews will vary, including questions that may be asked, the number of individuals conducting the interview, and the length of time an individual may spend in the interview. Also explain to students that interviewers often take notes to ensure that key points are remembered with regard to an applicant's answers, qualifications, etc.

**HINT:** To make the practice interview more realistic, invite members of your advisory committee to participate as the prospective employers (interviewers).

Target Position: Surgical Technologist

Applicant's Name: ______________________________

✔ **NOTE:** During the interview, the interviewer should observe the applicant for posture, eye contact, verbal skills, and professional appearance.

**INTRODUCTIONS**

Interviewer should greet applicant and introduce those individuals who will be participating in the interview process. The interviewer should also explain the process that will be used in the interview and give the applicant an opportunity to ask a question for clarification before proceeding. Generally, an applicant is given an opportunity to provide a little background information about himself/herself such as educational attainment and prior work experience.

**JOB ANNOUNCEMENT**

A copy of the job announcement describing the duties and responsibilities and requirements for the vacant surgical technologist position should be made available to the applicant as well as information about the health care facility (prospective employer). A general overview of benefits and work schedule are usually addressed during the interview process. Since this is a mock interview, you may just want to explain to the student that this information is provided in an actual job interview.

## Interview Questions

**MOTIVATIONAL FIT**

*The extent to which job activities and responsibilities and the organization's mode of operation and values are consistent with the type of environment that provides personal satisfaction; the degree to which the work itself is personally satisfying.*

1. Why did you choose the surgical technology profession as your career?

2. All jobs have their frustrations and problems. Describe some specific tasks or conditions that you have found frustrating. Why were they frustrating? How did you overcome the problem?

3. Unexpected changes can disrupt daily responsibilities. How do you feel when this happens? Why? What do you do to overcome these disruptions?

**WORK STANDARDS**

*Setting high goals or standards of performance for self, subordinates, others, and the organization; being dissatisfied with average performance; self imposing standards of excellence rather than having standards imposed by others.*

1. How many days of work have you missed in the past year? Why did you miss them?

2. Have you ever differed from your supervisor in the evaluation of your performance? What did you do?

**TOLERANCE FOR STRESS**

*Maintaining stable performance under pressure and/or opposition (e.g., time pressure, job ambiguity); relieving stress in a manner that is acceptable to the person and the organization.*

1. Have you ever faced an ethical or value conflict in your job? Explain. How did you react?

2. Describe a time when you faced a particularly stressful situation (emergency, deadline, etc.) How did you react? What was the result?

**ATTENTION TO DETAIL**

*Accomplishing tasks through concern for all areas involved, no matter how small; showing concern for all aspects of the job; accurately checking processes and tasks; maintaining watchfulness over a period of time.*

1. Describe the things you do to control errors in your work. Give an example.

2. Tell me about the most boring jobs or tasks you have had. Why were they boring? How did you handle the boredom?

**RESILIENCE**

*Handling disappointment and/or rejection while maintaining effectiveness.*

1. How have you reacted to criticism from your supervisor or person in authority?

## Interview Close

1. Do you understand that the surgical environment is a high risk area in regard to HIV and Hepatitis?

   Yes ______ No ______

2. Have you had your Hepatitis vaccination?

   Yes ______ No ______

3. What are your professional goals?
4. Give applicant the opportunity to ask questions. (Note the questions asked below.)
5. Explain the next step in selection process.
   - Receive letter by ______________________
   - If accepted, medical history form will be included, and information concerning due date for physical will be given.
   - If accepted, pending results of OSBI Records Search.
6. Thank applicant for productive interview.

## Teacher Supplement 4—Career Portfolio for Surgical Technology Students

✔ **NOTE:** Please refer to Optional Assignment Sheet 1, "Prepare a Career Portfolio," if your students will be developing career portfolios.

**DEFINITION**

The **Career Portfolio** is a student's collection of his/her favorite examples of work, accomplishments, and progress toward career goals.

**PURPOSE**

A portfolio is an effective way to show prospective employers evidence of an applicant's knowledge and skills and ability to perform job responsibilities as a surgical technologist.

Each student should be encouraged to prepare a portfolio over time to help document their individual accomplishments and goals, regardless of the length of time spent in the program or the level of competencies achieved. The career portfolio is individualized and should represent the student's best work as well as identify areas of needed improvement.

Students should also be encouraged to review and update the contents of their portfolio periodically, so that they will be better prepared to apply for a new job or seek a promotion as opportunities become available.

**BENEFITS**

As students develop their portfolios, they will learn the importance of monitoring their educational progress and career planning activities. This development process will assist students in highlighting their essential technical skills, an accomplishment that becomes a valuable tool in their future job search. Students will also benefit from the process of developing and maintaining a portfolio by:

- Learning to take responsibility for compiling portfolio materials that best demonstrate their strengths and skills.
- Increasing their awareness of the relationship between their growth and achievement and the attainment of their career goals.
- Learning to select those accomplishments that will best sell them to an employer and address marketplace needs.
- Identifying, practicing, and improving technical or academic skills in areas needing a higher competency level.
- Learning more about careers in their field of interest as well as the courses and skills necessary for achieving those careers.
- Improving the skills related to portfolio development such as writing and research.
- Increasing their self-esteem and confidence.

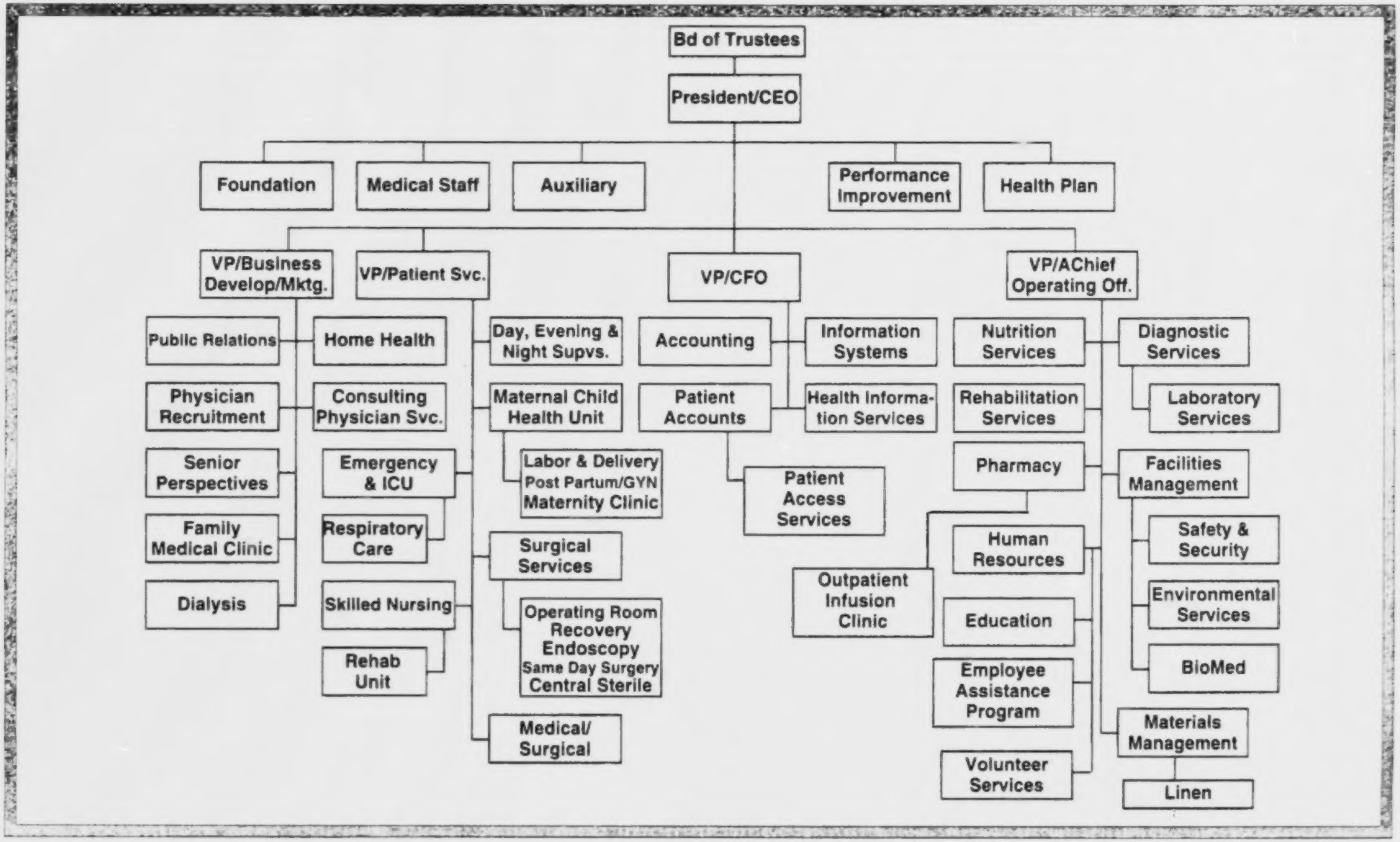
**CONTENT**

The career portfolio is truly a student-managed collection of experiences and projects. There are no required components—the content of each student's portfolio will vary according to the student's education/technical experiences and goals. Students should be oriented to the process of developing a portfolio and provided ideas for possible components such as the ones listed below.

- **Job-Related Skills.** Students should indicate full-time, part-time, paid, and unpaid work experiences. Items they may want to include are:
    - Internships or shadowing experiences
    - Documentation of skills demonstrated on the job
    - Class projects
    - Competency certificates
    - Photographs or videos of work projects
    - Instructor or mentor evaluations
    - Progress reports
- **Education Skills.** Students may include an overview of their educational achievements such as courses completed and examples of favorite class projects. Possible items to include are:
    - Technical skills
    - Appropriate academic skills
    - Transcripts
    - Courses taken that relate to career and educational goals
    - Photographs or videos or artwork from class projects
    - Test scores, ACT results, or SAT results
    - Writing or research projects
- **Employability Skills.** Students may describe and document experiences that reflect their interpersonal and dependability skills—those skills that demonstrate their professionalism. Skills may include:
    - Teamwork/interpersonal skills
    - Attendance/punctuality
    - Initiative/dependability
    - Written and verbal communication skills
    - Critical thinking and problem-solving skills
- **Career Development Plan.** Students may include materials that show their career and educational goals and plans for achieving them. They may also want to include items they have prepared to assist them in seeking employment with a health care facility. Possible items include:
    - 4 or 6 year plan of study
    - Career and educational goals
    - Résumé
    - Letter of application
    - Letters of reference

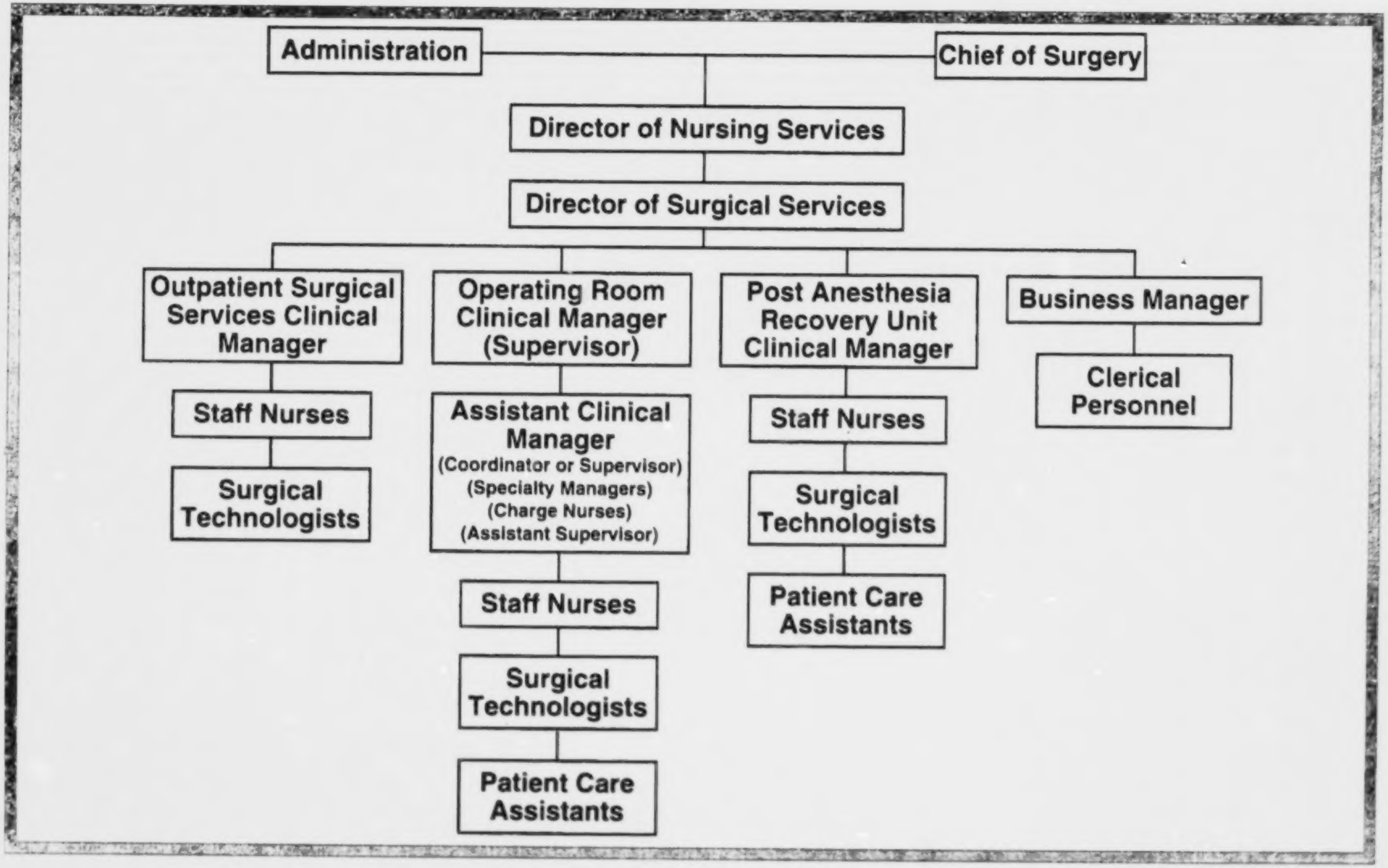
- **Activities, Awards, and Community Service.** Students may include descriptions of their special interests, activities, and achievements in school. It is also beneficial for them to provide information about their participation in community events, particularly volunteer work. Possible activities to highlight include:
    - ➤ Leadership activities
    - ➤ Sports, clubs, hobbies
    - ➤ Extracurricular activities
    - ➤ Awards
    - ➤ Volunteer or service learning experiences

# Organizational Chart for Medical Facility


Bd of Trustees
President/CEO
Foundation
Medical Staff
Auxiliary
Performance Improvement
Health Plan
VP/Business Develop/Mktg.
VP/Patient Svc.
VP/CFO
VP/AChief Operating Off.
Public Relations
Physician Recruitment
Senior Perspectives
Family Medical Clinic
Dialysis
Home Health
Consulting Physician Svc.
Emergency & ICU
Respiratory Care
Skilled Nursing
Rehab Unit
Day, Evening & Night Supvs.
Maternal Child Health Unit
Labor & Delivery
Post Partum/GYN
Maternity Clinic
Surgical Services
Operating Room
Recovery
Endoscopy
Same Day Surgery
Central Sterile
Medical/ Surgical
Accounting
Patient Accounts
Patient Access Services
Information Systems
Health Information Services
Nutrition Services
Rehabilitation Services
Pharmacy
Outpatient Infusion Clinic
Human Resources
Education
Employee Assistance Program
Volunteer Services
Diagnostic Services
Laboratory Services
Facilities Management
Safety & Security
Environmental Services
BioMed
Materials Management
Linen

Courtesy of Stillwater Medical Center, Stillwater, Oklahoma.

# OR Suite Organizational Chart



Administration

Chief of Surgery

Director of Nursing Services

Director of Surgical Services

Outpatient Surgical Services Clinical Manager

Staff Nurses

Surgical Technologists

Operating Room Clinical Manager (Supervisor)

Assistant Clinical Manager
(Coordinator or Supervisor)
(Specialty Managers)
(Charge Nurses)
(Assistant Supervisor)

Staff Nurses

Surgical Technologists

Patient Care Assistants

Post Anesthesia Recovery Unit Clinical Manager

Staff Nurses

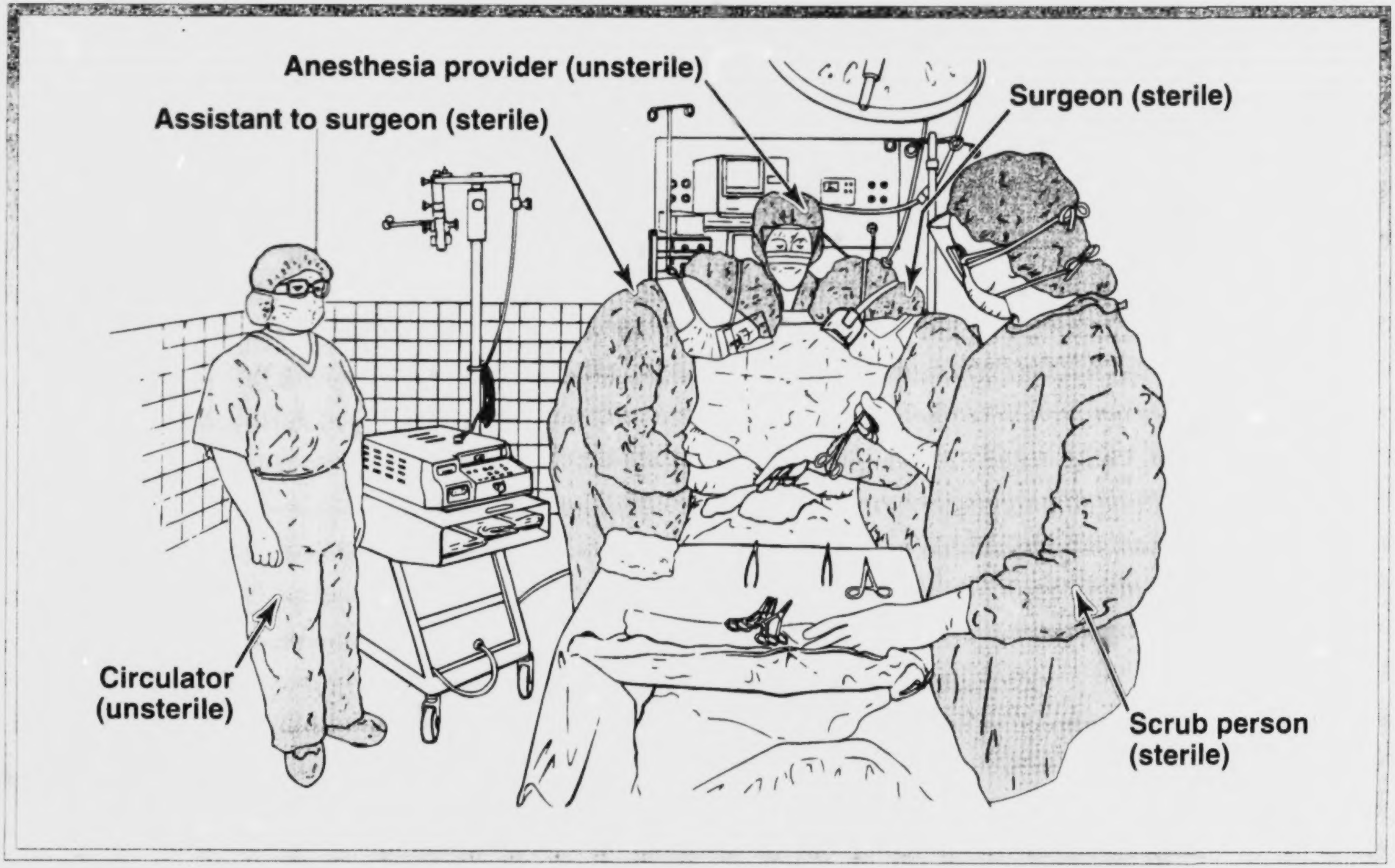
Surgical Technologists

Patient Care Assistants

Business Manager

Clerical Personnel

# Operating Room (OR) Team Members


Anesthesia provider (unsterile)
Assistant to surgeon (sterile)
Surgeon (sterile)
Circulator (unsterile)
Scrub person (sterile)

## Written Test

Name ______________________________

Date ________________ Score ________________

**OBJECTIVE 1** State the primary goal of surgical intervention. Write your answer on the blank lines provided below.

______________________________

______________________________

**OBJECTIVE 2** Match reasons for surgical intervention to their correct descriptions. Write the numbers on the blanks provided.

_____ a. To prevent the occurrence of a disease or illness

_____ b. To relieve or alleviate symptoms, without curing the underlying cause or disease

_____ c. To regain the patient's health and strength, so the patient may resume normal daily activities

_____ d. To determine the nature and cause of an illness

1. Diagnostic
2. Palliative
3. Prophylactic
4. Restorative

**OBJECTIVE 3** List the three types of hospitals and describe each. Write your answers on the blank lines provided below.

a. ______________________________

______________________________

______________________________

b. ______________________________

______________________________

______________________________

c. ______________________________

______________________________

______________________________

**Objective 4** List four facilities where surgery can be performed. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**Objective 5** Describe a typical hospital organizational chart. Write your answer on the blank lines provided below.

______________________________

______________________________

______________________________

______________________________

**Objective 6** Describe a typical hospital organizational structure for surgical services. Write your answer on the blank lines provided below.

______________________________

______________________________

______________________________

______________________________

**Objective 7** List six hospital departments on which the surgical suite depends to give continuity of patient care. Write your answers on the blank lines provided below.

Direct patient care

a. ______________________________

b. ______________________________

c. ______________________________

Indirect patient care

d. ______________________________

e. ______________________________

f. ______________________________

**OBJECTIVE 8** List the members of the surgical team. Write your answers on the blank lines provided below.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

**OBJECTIVE 9** Distinguish between sterile and unsterile team members by placing an "S" for sterile and a "U" for unsterile on the blanks next to the member names.

_______ a. Anesthesia provider

_______ b. Scrub person

_______ c. Surgeon

_______ d. Circulator

_______ e. Assistants to the surgeon

_______ f. X-ray technician or other specialists as needed

**OBJECTIVE 10** Match surgical team members to their correct functions. Write the numbers on the blanks provided.

_______ a. A licensed physician or a CRNA who provides anesthesia to the surgical patient

_______ b. Prepares the sterile field, scrubs and gowns the members of the surgical team, and prepares and sterilizes the instruments before and after the surgical procedure

_______ c. A licensed physician who performs the operative procedures and directs the OR team

_______ d. Responds to the needs of the scrubbed members within the sterile field before, during, and after the surgical procedure

_______ e. Physician and nonphysician allied health care workers who directly or indirectly assist with surgical procedures in the operating room

1. Anesthesia provider
2. Assistants
3. Circulator
4. Scrub person
5. Surgeon

**OBJECTIVE 11**

List five areas of employment for the surgical technologist. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

**OBJECTIVE 12**

List two ways of receiving training as a surgical technologist. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

**OBJECTIVE 13**

Complete statements concerning the job description of the surgical technologist. Write your answers on the blank lines provided in the statements below.

a. A job description is a written document that defines the ______________ of a position and the scope of work performed, and lists the requirements for the position.

b. A job description includes: ______________; nature of position; duties and ______________; ______________ requirements; credentials required; skills required; and immediate supervisor to whom position is accountable.

c. The purpose of a job description is to outline the ______________ of the position, establish the surgical ______________, and lay out the ______________ responsibility and accountability for the surgical technologist.

d. Job descriptions in the hospital help maintain safe and efficient operations by outlining the specific duties of all personnel.

e. All hospital job descriptions must meet the requirements of the ______________________________.

**OBJECTIVE 14**

Select from the following list the job responsibilities and functions of the scrub role by placing an "X" on the appropriate blanks provided below.

Preoperative

_______ a. Schedules operating rooms

_______ b. Obtains supplies

_______ c. Opens all sterile supplies needed for the procedure

_______ d. May assist in the transportation of patients into the surgical suite

_______ e. May assist with positioning the patient on the surgery table

_______ f. Assists in draping the patient with sterile drapes

_______ g. Performs surgical hand wash

_______ h. Assists in recovery by monitoring vital signs

_______ i. Assists surgeon with patient record keeping and postoperative care

Intraoperative

_______ j. Keeps the family informed

_______ k. Administers medication to the patient

_______ l. Maintains aseptic technique

_______ m. Anticipates the circulator's needs

_______ n. Assists surgeon when needed by retracting tissue, cutting sutures, sponging and suctioning blood from the wound, or irrigating the wound

_______ o. Chats with the surgeon

_______ p. Anticipates the surgeon's needs by watching the progress of the surgery, and by knowing the steps of the procedure involved

_______ q. Passes instruments, supplies, and equipment to the surgeon in a prescribed manner

_______ r. Identifies and cares for specimens received during surgery in a prescribed manner

_______ s. Connects electrical equipment to power sources during surgery

Postoperative

_______ t. Assists with application of dressing

_______ u. Assist with moving patient to stretcher or bed

_______ v. Maintains stock levels of supplies

_______ w. Leaves instruments and supplies for clean-up crew

_______ x. Maintains equipment in operating condition, and sends for repairs as needed

_______ y. Accompanies patient to post-anesthesia recovery room

**OBJECTIVE 15**

Select from the following list the job responsibilities and functions of the circulator by placing an "X" on the appropriate blanks provided below.

Preoperative

________ a. Plans, implements, and evaluates preoperative care

________ b. Assists with opening sterile supplies before surgery and as needed during surgery

________ c. Identifies patient, and performs preoperative assessment

________ d. Gowns and gloves the surgeon and assistants

________ e. Transports and positions patient on surgery table

________ f. Prepares the operative site by performing the scrub prep, and possibly the shave prep if needed

________ g. Assists in draping the patient with the sterile drapes

________ h. Assists the anesthesia provider when needed

________ i. Checks and connects electrical equipment to power sources, and connects suction to vacuum; handles nonsterile ends of equipment

Intraoperative

________ j. Is available to sterile team members and anticipates their needs

________ k. Obtains and prepares all medications as needed during the procedure and obtains blood products for transfusion as directed

________ l. Completes and maintains accurate operative records, including notation of any irregularities and incidents

________ m. Monitors patient vital signs in local or regional anesthetic cases

________ n. Assists surgeon by retracting tissue, cutting sutures, sponging and suctioning blood from the wound, or irrigating the wound

________ o. Observes for any breaks in aseptic technique

________ p. Is ultimately responsible for the identification and care of specimens received from person in the scrub role

Postoperative

________ q. Tapes postoperative dressing

________ r. Assists with moving patient to stretcher or bed

________ s. May accompany patient to Postanesthesia Recovery Room to give a nursing report of patient's progress, condition, and special equipment requirements

________ t. Performs proper clean up of equipment and supplies

________ u. May decontaminate and resterilize instruments and supplies

________ v. Maintains equipment in operating condition, and sends for repairs as needed

________ w. Maintains stock levels of supplies

**OBJECTIVE 16** List three limitations of the surgical technologist. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

*Permission to duplicate this test is granted.

# Answers to Written Test

**OBJECTIVE 1**

To allow the patient to be able to return to his/her best possible state of physical and mental health

**OBJECTIVE 2**

a. 3
b. 2
c. 4
d. 1

**OBJECTIVE 3**

a. Nonprofit—Affiliated with religious or other nonprofit organizations; cost of patient care is offset by charitable donations, and income is not taxed because any profits are returned to hospital to cover operating expenses

b. Proprietary—Privately owned and usually managed by a corporation; income is taxable and investors are entitled to a share of the profits

c. Tax supported—Receive funding from federal, state, or local governments

**OBJECTIVE 4**

Any four of the following in any order.
a. Hospital-based units
b. Satellite surgery center
c. Freestanding ambulatory surgery center
d. Office-based surgery center
e. Ambulatory care center/surgicenter
f. Clinic

**OBJECTIVE 5**

Description should include at least four of the following points.

a. The operating room (OR) where surgical intervention is performed is only one part of the larger unit, the operating room suite.

b. The operating room suite, similarly, is only one part of the larger unit, the medical facility.

c. Many people function in the medical facility, in both direct and indirect relationship with the patient.

d. Every employee's job is important, and each person has a job to perform that fits into the general scheme of the medical facility.

e. The surgical technologist should know his/her relationship to other individuals and departments in the medical facility.

f. Each medical facility, no matter how large or small, develops an organizational chart to show how all employees and their departments are related to the whole facility.

**Objective 5 (cont.)**

g. The organizational chart demonstrates the direct and associated lines of authority and is a pattern of control that links together responsibilities within the structure.

h. It is important that everyone within the organization follow the lines of authority when dealing with a problem. By using the appropriate method, the immediate supervisor can take action to accomplish the goals of the department.

**Objective 6**

Refer to Information Sheet to evaluate answer

**Objective 7**

Direct patient care (Answers should include any three of the following in any order.)

- Nursing care units
- Diagnostic imaging
- Blood bank
- Pathology
- Clinical laboratory
- Pharmacy
- Physical/occupational therapy

Indirect patient care (Answers should include any three of the following in any order.)

- Housekeeping
- Maintenance
- Purchasing/central services
- Administration
- Food service
- Medical records

**Objective 8**

Answers may appear in any order.

a. Surgeon
b. Assistants to the surgeon
c. Scrub person
d. Anesthesia provider
e. Circulator
f. X-ray technician, pathologist, or other specialists as needed

**Objective 9**

a. U
b. S
c. S
d. U
e. S
f. U

**Objective 10**

a. 1
b. 4
c. 5
d. 3
e. 2

**Objective 11**

Answers should include any five of the following. Answers may appear in any order.

a. Operating room
b. Emergency department/trauma center
c. Obstetrics department/labor and delivery room
d. Central processing or central service
e. Endoscopy unit
f. Cardiac catheterization lab
g. Tissue and retrieval team
h. Burn unit
i. Same-day/ambulatory surgery unit
j. Freestanding outpatient clinics/surgicenters
k. Doctors' offices
l. Private scrub for a surgeon
m. Home health care
n. Sales representative
o. Instructor in schools of surgical technology

**Objective 12**

Answers should include any two of the following. Answers may appear in any order.

a. Career and technical schools
b. College (private or public)
c. Armed forces

**Objective 13**

a. purpose
b. job title; responsibilities; educational
c. job duties; chain of command; legal
d.
e. Joint Commission of Accreditation of Healthcare Organizations (JCAHO)

**Objective 14**

Preoperative — b, c, d, e, f, g

Intraoperative — l, n, p, q, r

Postoperative — t, u, v, x

**Objective 15**

Preoperative — a, b, c, e, f, h, i

Intraoperative — j, k, l, m, o, p

Postoperative — q, s, t, u, v, w

**OBJECTIVE 16**

Answers should include any three of the following. Answers may appear in any order.

a. Never administers medication

b. Never administers anesthetic agents

c. Never functions in the operating room suite without proper supervision of a qualified registered nurse or physician

d. Never clamps tissues, places sutures, or alters body tissues in any way

e. Never obtains or administers blood

f. Never has final sign-off on operating room documentation

g. Never assesses physical or physiologic status of patient

## Answers to Assignment Sheets

### Assignment Sheet 1

Student performance should be evaluated according to the stated criteria and as appropriate to the health care facility selected by the student.

### Assignment Sheet 2

1. C
2. C
3. C
4. SP
5. C
6. C, SP
7. S
8. C
9. SP, C
10. C
11. SP, C
12. SP
13. A
14. C
15. C
16. C
17. SP
18. C
19. SP
20. SP, S
21. SP
22. SP
23. SP
24. C
25. SP, C
26. SP, S
27. SP, C
28. C
29. C
30. C
31. C
32. SP
33. SP
34. C, SP, A, S
35. SP, C

# Optional Assignment Sheet 1—Prepare a Career Portfolio

Name ______________________________ Date ____________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Documentation of skills was included | ______ |
| • Appropriate items were included for each section | ______ |
| • Portfolio was neat and legible | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________________________
________________________________________________
________________________________________________

---

**INTRODUCTION**

What is a Career Portfolio?

Students in school today may find themselves changing careers as many as seven to ten times during their lifetime. The workplace is demanding more from us—and asking for more evidence that we can get the job done. It is education's goal to prepare students for the world of work. Therefore, the concept of a career portfolio was devised.

A **career portfolio** is a collection of work that demonstrates the attainment of important knowledge and skills, and is designed to showcase a student's professional growth and achievement. The content of each student's portfolio will vary according to the student's educational/technical experiences and goals.

**MATERIALS**

3-ring, clear view binder (black or gray recommended)
13 top loading sheet protectors
Computer
Computer paper
Expandable binder, large
3 1/2" diskette
Items to be included

**EXERCISE**

**DIRECTIONS**

In this assignment, you will be given an opportunity to prepare your career portfolio, and you will have time to develop its contents as you prepare to become a surgical technologist. The following are some development tips to help you get started.

- **Collecting**—To begin the process of portfolio development, collect items that you would like to include in your portfolio such as any special projects, awards, or recognition. Place them in a large, expandable folder and continue to put new items you would like to include in your folder as you progress through the program. As they increase in number, you can evaluate them and begin the process of selecting the items you would like to include in your portfolio.
- **Organizing**—Your portfolio may be organized in a three-ring notebook, pocket folder, or on diskette. Your instructor may provide you with a customized notebook, folder, or computer-based system for you to use to compile your items. Everything should be neat and organized because this portfolio will provide the prospective employer with a first impression of your work. A table of contents should be included to assist the reader in reviewing your portfolio.
- **Reviewing**—Maintain your portfolio by keeping a list of all items included so that you can include a variety of samples of your work and accomplishments as you advance your skills.
- **Updating**—To further maintain the quality of your portfolio, review it often and update the contents so that it represents your best work. Continue to add materials such as awards, certificates, and samples of your work. You may wish to make copies of portfolio components in case your portfolio is lost to avoid having to start over.

### Setting Up Your Career Portfolio

Although contents will vary from student to student, you should include cover sheets and the four main sections listed on the next page in your career portfolio. These are listed in the order in which they should appear in your portfolio. However, some items for each section may be optional. Ask your instructor which items will be required for your portfolio.

### Cover Page

This may be provided by your instructor, and will be inserted in the front of your binder. If one is not provided, create your own and include:

- Title—Career Portfolio
- School name

**HINT:** Keep it simple. Your career portfolio should look professional.

### First Page

This may also be provided by your instructor, and will be the first page inside the binder. A blank sheet before this page is recommended to avoid having ink stick to inside binder if it gets hot or damp. If one is not provided, create your own, and include the following:

Portfolio
for
(Your Name)

### Table of Contents

An example is given on page 46. You can adapt it to your portfolio.

## Section A: Employment Credentials

- Cover letter
- Résumé
- References
- Letters of recommendation
- Follow-up letter (optional)
- Sample job application (optional)
- Personal profile (optional)

**HINT:** If you provided letters of recommendation for acceptance to the surgical technology program, ask your instructor for copies to include in this section of your portfolio.

## Section B: Surgical Technology Educational Records

This contains the important documentation from your clinical experiences. This won't be complete until you finish the program, but when you go for your interview, you can use what you have done up to that time.

✔ **NOTE:** This is a very important section because the people interviewing you will be able to see what your expertise is in.

- Clinical experience form
- Surgical procedures case log
- Attendance profile
- Course information/competency test results
- Certificates of completion
- Special licenses
- Class project and/or on-the-job training evaluations

## Section C: Other Educational Records

- Diplomas
- Transcripts
- Standardized test results

## Section D: Special Awards and Recognition

✔ **NOTE:** Include items in this section that reflect your participation in health-related activities and support your goal of becoming a surgical technologist.

- Certificates (contests, honor roll, attendance)
- Ribbons
- Medals
- Newsletter articles
- Newspaper articles
- Magazine articles

To assist you in developing your career portfolio, sample pages for a table of contents, cover letter, résumé, and follow-up letter have been provided.

## TABLE OF CONTENTS

**ITEMS** **SECTION**

EMPLOYMENT CREDENTIALS ........ A

Cover Letter ........ A1
Résumé ........ A2
References/Letters of Recommendation ........ A3
Follow-Up Letter ........ A4

SURGICAL TECHNOLOGY EDUCATIONAL RECORDS ........ B

Clinical Experience Form ........ B1
Surgical Procedures Case Log ........ B2
Attendance Profile ........ B3
Course Information ........ B4
Certificates of Completion ........ B5

EDUCATIONAL RECORDS ........ C

Diplomas ........ C1
Transcript ........ C2
Standardized Test Results ........ C3

SPECIAL AWARDS/RECOGNITION ........ D

Certificates ........ D1

## SAMPLE COVER LETTER

### *Your Name*

Address
Phone Number E-Mail Address

---

Date

Person or Department
Name of Hospital/Center
Address

To Whom It May Concern:

Please consider my application for the position of Surgical Technologist, as I would like the opportunity to work for Name of Health Care Facility.

I will be qualified to fill this position upon completion of the Surgical Technology program at Name of School on Date of Completion. This program includes a total of ______ hours of both didactic (______ hours) and clinical (______ hours) practice. The hospitals involved in our clinical study were Name of Facility, Name of Facility, and Name of Facility.

Thank you for your time and consideration of my application for the position of Surgical Technologist. Please find enclosed my résumé for your review. I can be reached at Phone Number to schedule an interview. I look forward to hearing from you.

Sincerely,

Your Name

Enclosure

## SAMPLE RÉSUMÉ

***Your Name***
**Address**

**Phone**
**Social Security Number**

---

**EMPLOYMENT OBJECTIVE:** Surgical Technologist

**EDUCATION:**
Name of Technical School (Year Graduated)
Address
Program: Surgical Technology

Name of High School (Year Graduated)
Address

**PROFESSIONAL CERTIFICATE:** Pending certification exam

**CLINICAL INTERNSHIP:**
Name of Center
Address

Name of Hospital
Address

**HEALTH SKILLS/ SPECIAL STUDIES:**

Surgical Competence in:
- Aseptic Technique
- General Surgery
- Gynecological Surgery
- (Include your own)

Limited Competence in:
- (List your own)

**WORK EXPERIENCE:**
Company Name From ______ To ______
Address
Job Title
Responsibilities

NOTE: List all the jobs you have worked.

**PROFESSIONAL ORGANIZATIONS:**
AST (Association of Surgical Technologists) Date
AST Chapter No. ___ Date
HOSA Date

**REFERENCES:** Available upon request

## SAMPLE FOLLOW-UP LETTER

***Your Name***

Address

Phone Number E-Mail Address

Date

Name of Individual (Interviewer)
Address

Dear Mr. or Ms./Mrs.:

Thank you for interviewing me for the position of Surgical Technologist at Name of Health Care Facility. I feel that the position you are filling would be an excellent match for me and that I have the education and training that will enable me to be a productive member of the surgical team.

Please feel free to contact me if you have any other questions.

Sincerely,

Your Name

## Answers to Optional Assignment Sheet

**Optional Assignment Sheet 1**

Evaluated by instructor.

## Module Review

Name ______________________________

Date ______________ Score ______________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 10

1. Which of the following scrubs and gowns the members of the surgical team?
   a. first assistant to the surgeon
   b. physician
   c. scrub person
   d. circulator

Objective 13

2. Which of the following is NOT typically included in a job description?
   a. skills required
   b. position responsibilities
   c. names of surgeons to assist
   d. educational requirements

Objective 5

3. Which of the following is NOT applicable to the hospital organizational chart?
   a. shows how employees and departments are related in the whole facility
   b. demonstrates the direct and associated lines of authority
   c. links together responsibilities within the structure
   d. lists names of all staff in the hospital facility

Objective 3

4. Which of the following statements is true?
   a. all hospitals are nonprofit enterprises
   b. all hospitals are frequently engaged in medical research projects
   c. all hospitals are specialized to treat one type of health problem
   d. all hospitals can be classified in more than one way

Objective 1

5. The primary goal of surgical intervention is to allow the patient ______.

   a. to return to his/her best possible state of physical and mental health
   b. to obtain emotional security
   c. to return to a state of wellness
   d. the chance to achieve a state of self-actualization

Objective 16

6. Which of the following may be performed by the surgical technologist?

   a. administer anesthetic agents
   b. place sutures
   c. administer medication
   d. assist with dressings

Objective 2

7. To prevent the occurrence of a disease or illness is an example of ______ surgical intervention.

   a. palliative
   b. prophylactic
   c. restorative
   d. diagnostic

Objective 4

8. Which of the following is NOT a suitable facility for surgery?

   a. satellite surgery center
   b. freestanding ambulatory surgery center
   c. private residence-based surgery center
   d. office-based surgery center

Objective 9

9. Sterile team members scrub (wash) their hands and arms and don ______ gowns and gloves before entering the sterile field.

   a. puerile
   b. sterile
   c. retardant
   d. petulant

Objective 12

10. In order to become a Certified Surgical Technologist, new applicants must be graduates of programs accredited by the ______.

    a. Association of Surgical Technologists (AST)
    b. Commission on Accreditation of Allied Health Education Programs (CAAHEP)
    c. Liaison Council on Certification for the Surgical Technologist (LCC-ST)
    d. Accreditation Review Committee on Education in Surgical Technology (ARC-ST)

Objective 15

11. The circulator stays ______ the sterile field.

    a. inside
    b. outside
    c. within
    d. a part of

Objective 14

12. Preoperative responsibilities of the surgical technologist in the scrub role include which of the following?

    a. assisting with dressing
    b. passing instruments to the surgeon in a prescribed manner
    c. assisting in draping the patient with sterile drapes
    d. preparing and passing medication to surgeon

Objective 11

13. Which of the following is NOT a likely area of employment for the surgical technologist?

    a. same day/ambulatory surgery unit
    b. obstetrics department/labor and delivery
    c. instructor in schools for registered nursing programs
    d. emergency department/trauma center

Objective 7

14. The ______ performs viral, microbiological, metabolic, molecular, and other tests on patient blood, fluids, and tissue samples.

    a. pathology department
    b. blood bank
    c. diagnostic imaging staff
    d. clinical laboratory

Objective 6

15. Which of the following statements is NOT true?

    a. Nursing assistants clean, process, and store instruments and supplies; perform housekeeping duties, and assist with transportation and positioning of patients.

    b. The Director of Surgery may be a physician or registered nurse who is directly responsible for everything and everyone in the operating room suite.

    c. Allied health care professionals direct surgical technologists in the OR suite.

    d. The OR Clinical Manager is usually a registered nurse who assists the Director of Surgery with the management of the OR suite.

Objective 9

16. Which of the following function within the sterile field?

    a. x-ray technician

    b. circulator

    c. anesthesia person

    d. scrub person

Objective 10

17. The anesthesia provider is a licensed physician or ______; both require special training to administer anesthesia.

    a. Certified Surgical Technologist Anesthetist (CSTA)

    b. Certified Registered Nurse Anesthetist (CRNA)

    c. Certified Perfusionist Anesthetist (CPA)

    d. Certified Scrub Anesthetist (CSA)

Objective 15

18. Which of the following is the responsibility of the circulator?

    a. hands the scrub person samples and specimens after they are obtained from the surgeon

    b. completes and maintains accurate operative records including notes about irregularities and incidents

    c. advises patients on billing options

    d. tells the physician first assistant when to bring in support personnel

Objective 2

19. To regain the patient's health and strength so the patient may resume normal daily activities is an example of ______ surgical intervention.

    a. palliative

    b. prophylactic

    c. restorative

    d. diagnostic

Objective 9

20. The ______ handles supplies and equipment that are not considered sterile.

    a. circulator

    b. nonphysician first assistant

    c. assistant to the surgeon

    d. scrub person

Objective 11

21. Which of the following is the most likely area of employment for the surgical technologist?

    a. clinical laboratory

    b. diagnostic imaging

    c. central supply

    d. same day/ambulatory surgery unit

Objective 15

22. Which of the following is NOT a responsibility of the circulator?

    a. obtains blood products for transfusion as directed

    b. assists the anesthesia provider when needed

    c. identifies patient, and performs preoperative assessment

    d. assists the surgeon with cauterization and irrigation

Objective 16

23. Even if qualified and acting as first assistant, a surgical technologist may not ______.

    a. alter body tissues

    b. retract tissue

    c. cut sutures

    d. sponge and suction blood from the wound

Objective 2

24. To determine the nature and cause of an illness is an example of ______ surgical intervention.

    a. palliative

    b. diagnostic

    c. restorative

    d. prophylactic

Objective 4

25. Which of the following is NOT related to the term *ambulatory*?

a. long-term health care
b. outpatient surgery
c. same day surgery
d. not formally admitted to a facility for an extended stay

Objective 5

26. In a typical organizational structure, the ______ is the higher authority.

a. Director of Nursing
b. Director of Surgery
c. OR Clinical Manager
d. President/CEO

Objective 7

27. ______ is an example of indirect patient care.

a. Pathology
b. Purchasing/Central services
c. Blood bank
d. Clinical laboratory

Objective 10

28. The ______ responds to the needs of the scrubbed members within the sterile field before, during, and after the surgical procedure.

a. circulator
b. surgeon
c. scrub person
d. physician first assistant

Objective 2

29. To relieve or alleviate symptoms without curing the underlying cause or disease is an example of ______ surgical intervention.

a. palliative
b. prophylactic
c. restorative
d. diagnostic

Objective 3

30. A ______ hospital is privately owned and usually managed by a corporation.

    a. nonprofit
    b. proprietary
    c. tax-supported
    d. university

Objective 6

31. Clerical personnel are ancillary workers who maintain records and reports, order supplies, and assist in ______.

    a. storing instruments and surgical supplies
    b. performing housekeeping duties
    c. the management of the OR
    d. scheduling surgeries

Objective 4

32. A facility that is owned and operated by a hospital, but that is physically separated from the hospital is a ______ center.

    a. freestanding ambulatory surgery
    b. office-based surgery
    c. satellite surgery
    d. same day surgery

Objective 7

33. Which is NOT an example of direct patient care?

    a. pathology
    b. pharmacy
    c. housekeeping
    d. blood bank

Objective 8

34. Which may NOT be a member of the core surgical team?

    a. pathologist
    b. circulator
    c. scrub person
    d. assistant to the surgeon

Objective 10

35. Which of the following is true about the Physician First Assistant?

a. can be a surgical technologist with special training
b. not allowed to perform certain parts of the procedure
c. must have same credentials as the surgeon
d. must be a registered nurse with special training

Objective 14

36. Which of the following is a preoperative responsibility of the surgical technologist in the scrub role?

a. obtains all medication necessary for the procedure
b. handles nonsterile ends of equipment
c. obtains specimens necessary for the procedure
d. assists circulator in opening sterile supplies necessary for the procedure

Objective 13

37. The job description establishes the surgical chain of command and lays out the ______ for the surgical technologist.

a. legal responsibility and accountability
b. career options
c. union rules
d. doctor's preferences

Objective 14

38. Which of the following is an intraoperative responsibility of the surgical technologist in the scrub role?

a. assists the x-ray technician as necessary
b. passes instruments, supplies, and equipment to surgeon in a prescribed manner
c. counts sponges, needles, and instruments while awaiting surgeon's instructions
d. decontaminates and resterilizes instruments

Objective 14

39. Which of the following is a postoperative responsibility of the surgical technologist in the scrub role?

a. assists the anesthesia provider when needed
b. washes blood off patient
c. identifies specimens received during surgery
d. assists with moving patient to stretcher or bed

Objective 10

40. Which of the following prepares and sterilizes instruments?

 a. first assistant to the surgeon

 b. physician

 c. scrub person

 d. circulator

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. c
2. c
3. d
4. d
5. a
6. d
7. b
8. c
9. b
10. b
11. b
12. c
13. c
14. d
15. c
16. d
17. b
18. b
19. c
20. a
21. d
22. d
23. a
24. b
25. a
26. d
27. b
28. a
29. a
30. b
31. d
32. c
33. c
34. a
35. c
36. d
37. a
38. b
39. d
40. c

# Introduction to Surgical Technology

## SECTION A:
## Orientation to Surgical Technology

### Module 2-A: Interpersonal Relationships and Communication Skills

## Module Contents

**COMPONENTS**

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Teacher Supplements

1—Guidelines for Written Communication . . . . . . . . . . 9
2—The Phonetic Alphabet . . . . . . . . . . 11

Transparency Masters

1—Maslow's Hierarchy of Needs . . . . . . . . . . 13
2—Components of Communication . . . . . . . . . . 15

Written Test . . . . . . . . . . 17

Answers to Written Test . . . . . . . . . . 25

Answers to Assignment Sheets . . . . . . . . . . 29

Module Review . . . . . . . . . . 33

Answers to Module Review . . . . . . . . . . 41

## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Review teacher supplements and make copies of any that will be provided for each student.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

- Demonstrate the components of communications. Cut out three shapes from poster board, three sizes per shape. You will need one set of shapes per student. Divide students into pairs. One student is to be the engineer and one the builder. Arrange student desks back to back. The engineer creates a design. The next task for the engineer is to communicate to the builder how to recreate the design without using the following: size, shape, or color (if colored) of the designs. The builder can only say "ok" or "repeat." You will need to put a time limit on each part of the exercise. When builders are finished, have them turn around and compare their creation with the original. Have the students switch roles. Discuss factors involved.
- To reinforce listening skills, read a piece of written communication to the class, and then ask them specific questions about the communication message. The piece to be read could be a short article from a newspaper or magazine, one page from a novel, a résumé, or a work-related report or record. Students should not be allowed to take notes while you read. This will help students test their listening and memory skills.
- Contact your local telephone companies and request handouts and/or demonstrations of telephone etiquette. Then discuss the handouts or demonstrations.
- Collect forms from your local surgery departments and have students practice filling them out.
- Divide the class into groups of three or four and have them write a brief situation involving difficult communication situations. Have each group present their situation and conduct a two-minute discussion of effective methods to handle the situations.
- Invite a panel with members of different ethnic backgrounds to discuss cultural influences on communication and health care practices.
- Have students give oral and written reports on interpersonal relationships or communication topics.
- Demonstrate observation skills. With students in pairs, have them stand and face each other for five seconds and observe each other. Then turning back to back one student takes ten seconds to make three changes in his/her appearance. For example, they could remove a ring, unbutton a button, and roll up a sleeve. They then turn face to face and the observer has five seconds to tell the other person what changes were made. Let students trade places.

- Demonstrate nonverbal communication skills. Divide the class into groups of three to five students per group. Pass out 3x5 cards with nonverbal communications listed. Give each group different nonverbal communications. Use both positive and negative. Each group presents their signals while the rest of the group writes down what they think the nonverbal communication is and if it is positive or negative.
- Have students break into groups and discuss their answers to the assignment sheets prior to or instead of grading assignment sheets.

## RESOURCES USED IN DEVELOPING THIS MODULE

### Books

- Caruthers, Bob L., and Paul Price, ed. *Surgical Technology for the Surgical Technologist—A Positive Care Approach.* Albany, NY: Delmar, 2001.
- Ellis, David. *Becoming a Master Student.* 9th ed. Boston: Houghton Mifflin College, 2000.
- Fortunato, Nancymarie. *Berry and Kohn's Operating Room Technique.* 9th ed. St. Louis: Mosby, Inc., 2000.
- Fuller, Joanna R. *Surgical Technology—Principles and Practice.* 3rd ed. Philadelphia: W. B. Saunders Co., 1994.
- *Introduction to Surgical Technology.* 2nd ed. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1994.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery.* 11th ed. St. Louis: Mosby, Inc., 1999.
- Phippen, Mark L., and Maryann Papanier Wells. *Perioperative Nursing Practice.* Philadelphia: W. B. Saunders Co., 1994.
- *Practical Nursing Series—Nursing Concepts.* Stillwater, OK: Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1998.

### Pamphlet

- *Competency Statements for the Surgical Technologist.* Littleton, CO: Association of Surgical Technologists, Inc.

### Magazine Articles

- Cassells, J. M., and B. Redman. "Preparing Students to be Moral Agents in Clinical Nursing Practice: Report of a National Survey." *Journal of the Nursing Clinics of North America* 4 (1989): 465.
- Davidhizar, Ruth. "Surgeon—Assistant Communication." *Today's Surgical Nurse* (May/June 1998): 33-36.
- Kircher, Edwin L. "Survival Tactics for Surgical Technologists." *Student Connection* (Spring 1999): 2-3.
- Melton, Barbara. "Silent Communications Used in the Operating Room." *Ethicon* 14, no. 2 (1977).

**Web Site**

- http://www.howardcc.edu/health

  McMurtrie, Christine R. *Success in Nursing Series.* Retrieved November 28, 2001, from Howard Community College Web site.

### SUGGESTED SUPPLEMENTAL RESOURCES

- *Communications: The Process.* 25-minute video explores effective speaking and listening skills in today's health care facility.
- *Communications: Peer Relationships.* 18-minute video describes how to improve professional working relationships with coworkers and patients.

Available from:

Medcom, Inc.
6060 Phyllis Drive
Cypress, CA 90630
800-877-1443
www.medcominc.com

- *Enhancing Communication in the Perioperative Setting.* 2000. 20-minute video contains strategies to enhance communication skills.
- *Effective Team Building in the Operating Room.* 1998. 15-minute video demonstrates how to effectively communicate with your team members to accomplish the final goal of quality patient care.
- *Effective Conflict Resolution Strategies in the Operating Room.* 1997. 17-minute video offers several effective ways to address conflicts, find solutions, and improve the working environment.

Available from:

Ciné-Med, Inc.
127 Main Street North
Woodbury, CT 06798
800-253-7657
www.cine-med.com

### SUGGESTED WEB SITES*

- http://novaonline.nv.cc.va.us/eli/spd110td/interper/index.html

  The Interpersonal Web provides information on cultural context, communication process, self concept, listening & perception, verbal and nonverbal messages, types of relationships, and the communication process.

- http://www.worldsurgeons.org/empathy.htm

  The World Surgeons' Web site contains a pretest, analysis of score, and exercises on active listening and empathy.

- http://www.findarticles.com/cf_0/m3231/6_30/62799620/p1/article.jhtml?term=communication

  This online article from *Nursing* discusses techniques to improve the way you communicate with your patients.

- http://www.advancefornurses.com/

  The online edition of *Advance for Nurses* contains several articles on effective communication.

- http://www.tusc.kent.edu/nursing/thercomm.htm

  This Web Site discusses techniques of therapeutic communication as well as deterrents to therapeutic communication.

- http://nsweb.nursingspectrum.com/cfforms/tipsforeffectivecommunication.cfm

  Nursing Spectrum Career Fitness Online contains ten tips to effective communication in the health care field.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

## Teacher Supplement 1—Guidelines for Written Communication

One way health care professionals communicate is by written means such as memos, proposals, e-mail, and other forms of computer communication. Following a few guidelines will help you send clear messages.

**MEMO**

A memo is generally one page in length. It should be brief but clear. The heading of a memo should include who it is to (including full name and title), who it is from, the complete date (day, month, and year), and the subject. The body of the memo should directly address the subject in clear, concise words. An example of this might be a request for a schedule change written to the staffing coordinator listing specific dates that you would like to be scheduled only for the night shift.

**INFORMAL PROPOSAL**

An informal proposal is a way to communicate a problem or potential problem and a proposed solution to the problem. The proposal should be addressed to the appropriate person, the one who has the power to make a decision. The problem should be clearly stated in the opening paragraph. The attempt to solve the problem should be clearly explained in the second paragraph. It should include any cost involved in implementing the proposed solution, what tasks will need to be performed, and areas of responsibility in solving the problem.

**COMPUTER COMMUNICATION**

Computer communication serves a major role in health care. In most instances, you will be filling out a form on the computer, instead of on paper, to requisition supplies and equipment. It is important to review your content for typos or other errors. Electronic mail (e-mail) is an excellent tool for routine communication such as scheduling or providing noncritical information to others. However, when there is a real problem to be discussed, it is a very poor substitute for face-to-face communication.

## Teacher Supplement 2—The Phonetic Alphabet

Caller: "I'd like to order a model B-25."

Supplier: "Right, one D-25."

Caller: "No, a B-25."

Supplier: "Oh, a V-25."

Caller: "Yes, that's right. And I need it shipped for deliver tomorrow."

Supplier: "You got it."

*Or do they?*

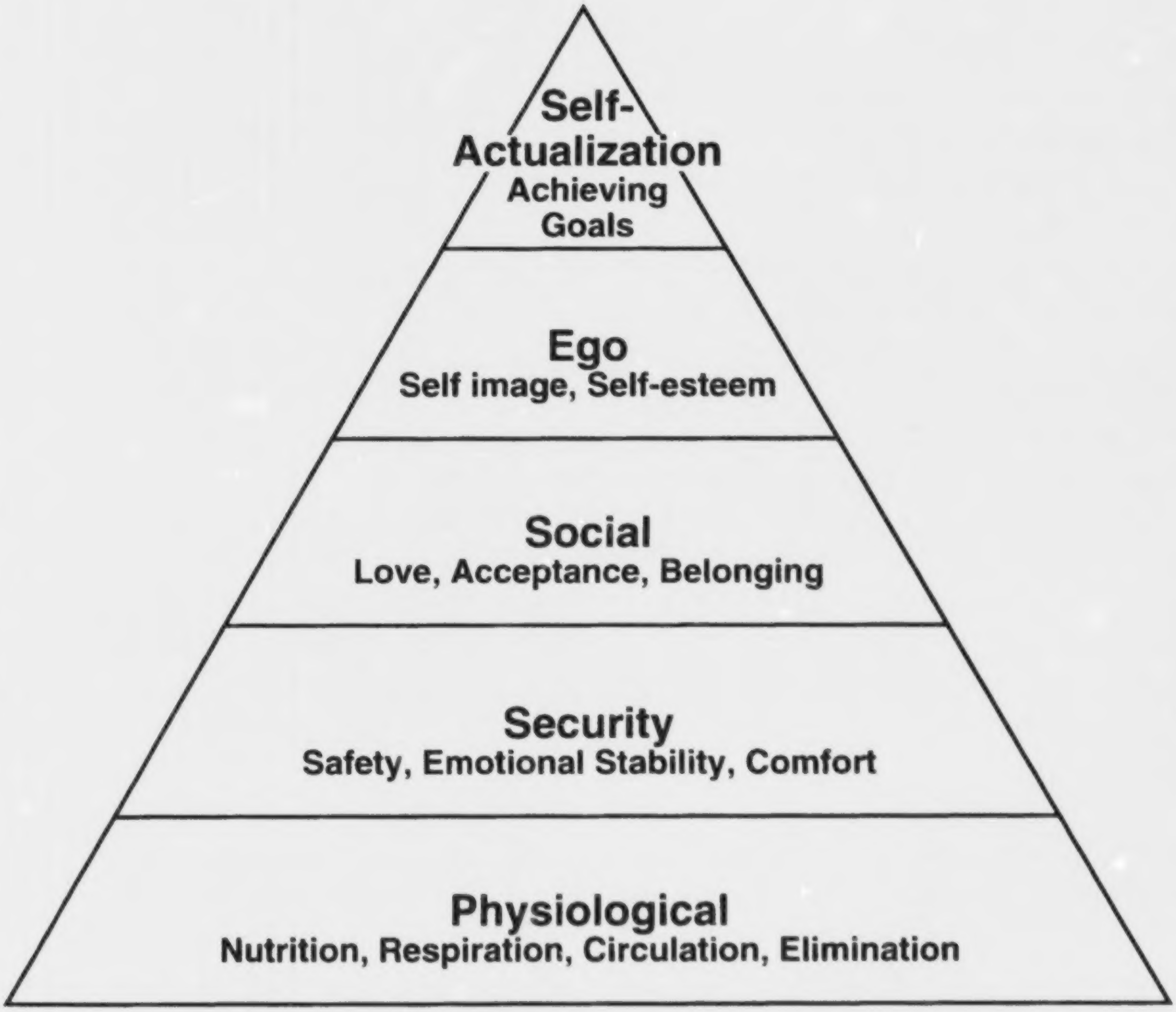
Critical communicators such as air traffic controllers and police dispatchers use the phonetic alphabet to avoid miscommunications such as the above. While it takes some getting used to, it certainly helps you be clear about what you are specifying. If the caller had specified a "B, as in bravo, dash 25" they would more than likely get the item they needed, when they needed it.

You can make up your own, and it will certainly help, but the following is a popular, tried-and-true phonetic alphabet:

| | | | |
|---|---|---|---|
| A–Alpha | H–Hotel | O–Oscar | V–Victor |
| B–Bravo | I–India | P–Papa | W–Whiskey |
| C–Charlie | J–Juliet | Q–Quebec | X–Xray |
| D–Delta | K–Kilo | R–Romeo | Y–Yankee |
| E–Echo | L–Lima | S–Sierra | Z–Zulu |
| F–Foxtrot | M–Mike | T–Tango | |
| G–Golf | N–November | U–Uniform | |

✔ **NOTE:** This alphabet dates from about 1955 and is used by NATO, the International Civil Aviation Organization, the FAA, and the International Telecommunication Union.

# Maslow's Hierarchy of Needs



**Self-Actualization**
Achieving Goals

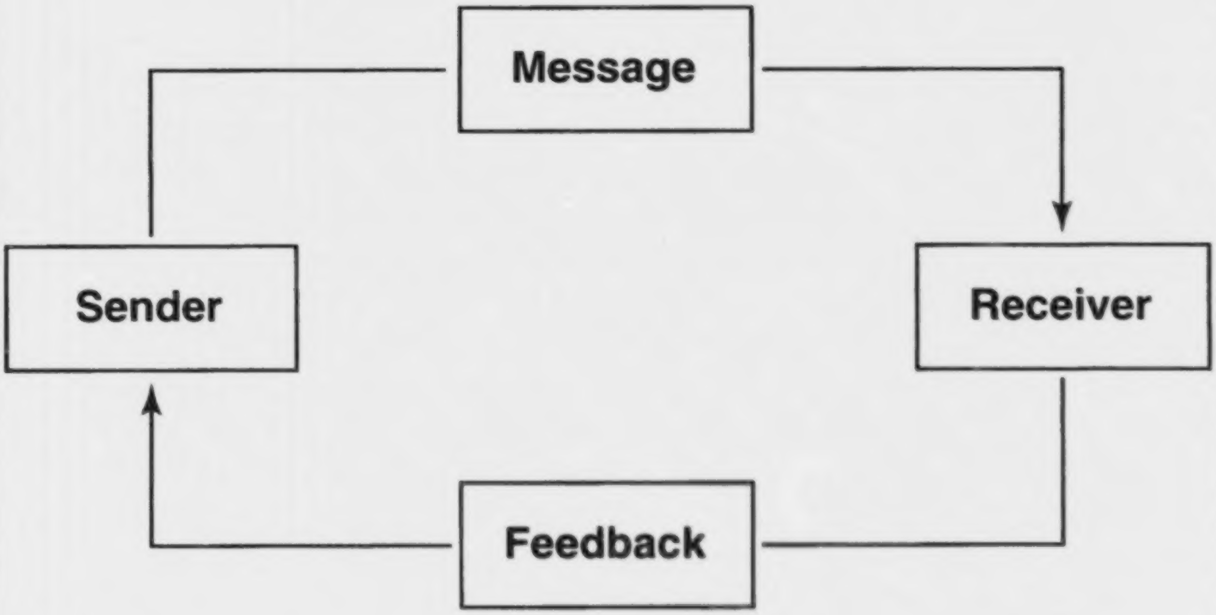
**Ego**
Self image, Self-esteem

**Social**
Love, Acceptance, Belonging

**Security**
Safety, Emotional Stability, Comfort

**Physiological**
Nutrition, Respiration, Circulation, Elimination

# Components of Communication



Message

Sender

Receiver

Feedback

## Written Test

Name ______________________________

Date ____________________ Score ____________________

**OBJECTIVE 1** Distinguish among types of relationships by placing an "S" next to descriptions of social relationships, a "P" next to descriptions of professional relationships, and a "T" next to descriptions of therapeutic relationships.

_______ a. Behavior limited by social protocol, but feelings, ideas, and actions are expected to be shared and respected

_______ b. Not a mutual relationship

_______ c. Mutual relationship

_______ d. Limited to conduct under job description

_______ e. Between patient and health care team members

_______ f. May be casual or intimate, brief or longlasting

_______ g. Goal directed

_______ h. Not goal directed

_______ i. Relationship lasts as long as needed to perform service to patient

_______ j. Between co-workers of a profession

_______ k. Involves the care and treatment of the patient by the health care team

_______ l. Between peers

_______ m. Behavior is guided by ethical code and policies of institution, along with common courtesy and good manners

**OBJECTIVE 2** Select from the following list the factors needed for good relationships by placing an "X" in the appropriate blanks. The list is continued on the next page.

_______ a. Open expression of feelings

_______ b. Recognizing and meeting your needs

_______ c. Recognizing and meeting the other person's needs

_______ d. Similar interests and hobbies

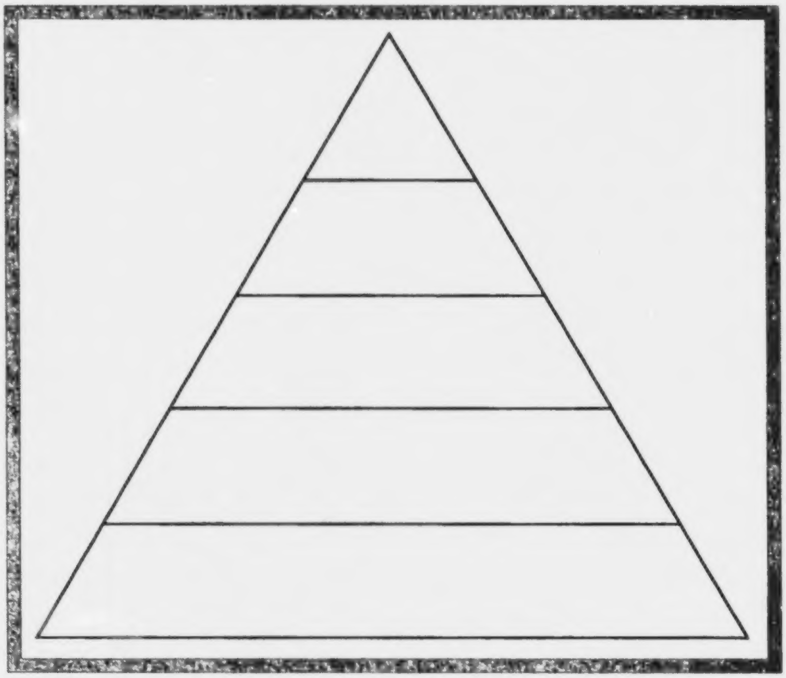
________ e. Love

________ f. Effective communication

________ g. Behaving in the correct manner at the correct times

________ h. Financial rewards

**OBJECTIVE 3** Arrange in order Maslow's hierarchy of human needs by placing the following needs in their correct order in the pyramid below: Ego, physiological, security, self-actualization, and social.



**OBJECTIVE 4** List the causes of stress in the operating room, the impact of stress on the body, and methods of coping with stress. Write your answers on the blank lines provided below and on the next page.

a. List five causes of stress in the operating room.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

b. List four impacts of stress on the body.

- ____________________
- ____________________
- ____________________
- ____________________

c. List five methods of coping with stress.

- ____________________
- ____________________
- ____________________
- ____________________
- ____________________

**OBJECTIVE 5** Select from the following list true statements concerning psychosocial stress in the patient and within the surgical team by placing an "X" in the blanks next to the true statements.

______ a. Patients may react to their fear and anxiety by showing resentment or hatred toward the health care team.

______ b. Surgical team members should never allow the patient to verbalize or explore their fears and grief.

______ c. Children may experience stress because they are afraid of injections and pain.

______ d. Elderly patients can experience disorientation, confusion, and depression, and may require extra care and patience.

______ e. Patients who are under stress may exhibit physical changes such as muscular tension, trembling hands, and increased heart and respiratory rates.

______ f. Pediatric patients may experience overwhelming separation anxiety which can be a major cause of stress for them.

**OBJECTIVE 6** List three goals of communication. Write your answers on the blank lines provided below.

a. ____________________

b. ____________________

c. ____________________

**OBJECTIVE 7**

Match the means of communication to their correct descriptions. Write the numbers on the blanks provided.

______ a. Communication using words

______ b. Communication in which words are written; depends on the abilities to write, read, and see

______ c. Communication sent in ways other than by words; depends on the five basic senses

______ d. Communication in which words are spoken aloud; depends on the abilities to speak and hear

1. Nonverbal
2. Oral
3. Verbal
4. Written

**OBJECTIVE 8**

State three of the purposes of communication among hospital team members. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

**OBJECTIVE 9**

List the essential components of effective communication. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 10**

List effective listening skills utilizing the components of communication. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

**OBJECTIVE 11**

Describe three of the effective speaking skills. Write your answers on the blank lines provided below.

a. ______________________________

______________________________

b. ______________________________

______________________________

c. ______________________________

______________________________

**OBJECTIVE 12**

Identify three means of communication that enable other hospital departments to relate to the surgical suite and assure continuity of patient care and safety. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

**OBJECTIVE 13**

Select true statements concerning the importance of effective communication for the patient undergoing surgery by placing an "X" in the appropriate blanks.

_______ a. Communication is the basis for the continuum of patient care and teamwork among the staff.

_______ b. Patients under the stress and anxiety of their upcoming surgery don't need to communicate their feelings. It is better if they keep their feelings to themselves.

_______ c. Patients indicate their needs by what they say (verbal) and by what they do not say (nonverbal). The surgical team must listen and observe for both types of communication.

_______ d. Effective communication does not influence the patient's attitude toward surgery and health care workers.

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**OBJECTIVE 14**

Match techniques for therapeutic communication to their correct examples. Write the numbers on the blanks provided.

_______ a. Patient: "I hate waiting here. I'm so frustrated."
Care giver: "You are frustrated with waiting."

_______ b. "My name is José Rodriguez. I'm taking you to the operating room where your surgery is scheduled."

_______ c. "Yes...Oh?...Go on...I see."

_______ d. "Is there something bothering you?"

_______ e. "You're trembling. You seem upset. Am I wrong?"

_______ f. Care giver: "I'm not sure I understand. Are you saying that..."

_______ g. Patient: "I hate waiting here."
Care giver: "Yes, it must be frustrating for you."

_______ h. Care giver: ....

_______ i. Patient: "I'm tired, and I don't like it here."
Care giver: "You're tired?"

_______ j. Care giver: Covers patient, then asks, "Are you warmer now?"
Patient: "Yes."
Care giver: "Is there anything else you need?"
Patient: "No, I'm fine now."

1. Using broad opening statements
2. Using general leads
3. Giving information to the patient
4. Sharing observations with the patient
5. Acknowledging the patient's feelings
6. Reflecting (paraphrasing)
7. Selective reflecting
8. Using silence
9. Clarifying
10. Validating

**Objective 15**

Match blocks to therapeutic communication to their correct examples. Write the numbers on the blanks provided.

_______ a. "What you should do is..."

_______ b. Patient: "I wish I could just die."
Care giver: "What did you have for breakfast this morning?"

_______ c. "Everything will be okay." "Don't worry, be happy."

_______ d. "Why are you doing that?"

_______ e. Patient: "I wish I were dead."
Care giver: "I know just how you feel. Everyone feels that way."

_______ f. "You're wrong."

_______ g. Patient: "I don't like this old hospital."
Care giver: "This is NOT an old hospital. We have the most up-to-date equipment in the entire state."

_______ h. "Yes, that's good. I agree with you."

1. Using clichés
2. Giving advice
3. Giving approval or agreement
4. Requesting an explanation
5. Belittling the patient's feelings
6. Expressing disapproval or disagreement with the patient
7. Defending
8. Changing the subject

**Objective 16**

Select from the following list the correct communication requirements while in surgery by placing an "X" in the appropriate blanks.

_______ a. List carefully and speak clearly while wearing an operating room mask.

_______ b. Communicate professionally by using slang.

_______ c. Follow verbal directions quickly and correctly.

_______ d. Do not use nonverbal communication.

_______ e. Communicate therapeutically with patients and their families.

***Permission to duplicate this test is granted.**

## Answers to Written Test

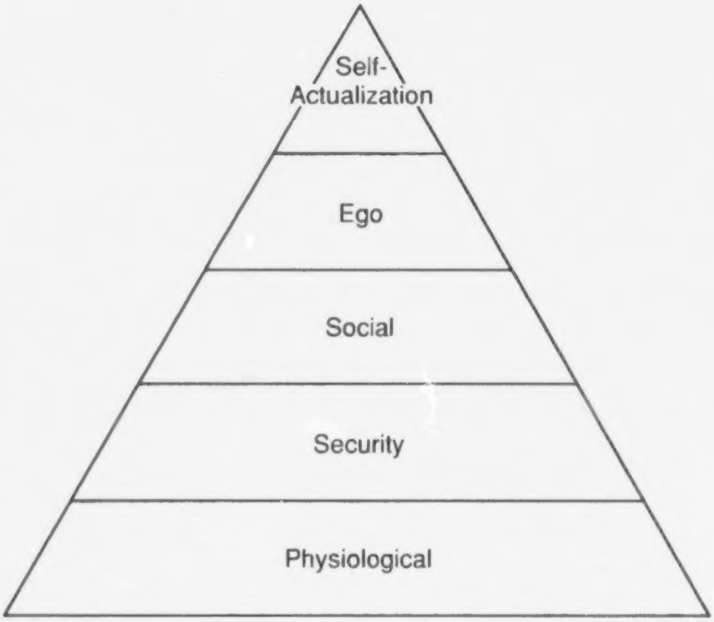
**OBJECTIVE 1**

a. S
b. P or T
c. S
d. P
e. T
f. S
g. P or T
h. S
i. T
j. P
k. T
l. S
m. P

**OBJECTIVE 2**

b, c, f, g

**OBJECTIVE 3**



**OBJECTIVE 4**

a. Answers should include any five of the following causes of stress in the operating room. Answers may appear in any order.

- General surgical environment (sound, smell, sights)
- Team member personalities
- Emergency situations
- Unfamiliar procedures
- Malfunctioning equipment
- Incorrent or insufficient supplies and tools
- Breach in aseptic technique
- Situations involving moral, ethical, and legal dilemmas or challenges

**OBJECTIVE 4 (CONT.)**

b. Answers should include any four of the following impacts of stress on the body. Answers may appear in any order.

- High blood pressure
- Headache
- Loss of appetite
- Increased appetite
- Weakened immune system
- Heart failure

c. Answers should include any five of the following methods of coping with stress. Answers may appear in any order.

- Exercising
- Imagery
- Deep breathing
- Muscle relaxation
- Getting enough sleep
- Humor
- Positive reflection on your day's events
- Eating healthy, regular meals
- Caring for your physical and emotional needs
- Professionally, yet assertively dealing with sources of conflict

**OBJECTIVE 5**

a, c, d, e, f

**OBJECTIVE 6**

Answers should include any three of the following. Answers may appear in any order.

a. To give information to others
b. To obtain information from others
c. To express feelings
d. To solve problems through communication
e. To persuade others to change an attitude or behavior

**OBJECTIVE 7**

a. 3
b. 4
c. 1
d. 2

**Objective 8**

Answers should include any three of the following. Answers may appear in any order.

a. To maintain accurate records

b. To promote employee relations within the surgical team and between the surgical team and other hospital departments

c. To promote teamwork within the surgical unit

d. To provide continuity of patient care as efficiently and cost-effectively as possible

e. To identify patient needs

f. To ensure that legal aspects are considered

**Objective 9**

Answers may appear in any order.

a. Sender
b. Message
c. Receiver
d. Feedback

**Objective 10**

Answers may appear in any order.

a. Defer judgment.
b. Listen for the whole message.
c. Pay attention.
d. Listen completely.
e. Paraphrase what was heard.

**Objective 11**

Answers should include any three of the following. Answers may appear in any order.

a. Assess—Determine purpose and audience.

b. Plan—Determine what to say and how.

c. Present—Be sincere. Be aware of voice tone, fluency, articulation, and nonverbal communications.

d. Listen—Listen to feedback and look for nonverbal cues from the audience.

e. Evaluate—Use feedback to see if the correct message was received.

**Objective 12**

Answers should include any three of the following. Answers may appear in any order.

a. Records
b. Requisitions
c. Inservice program
d. Computers
e. Verbal

**Objective 13**

a, c

**Objective 14**

a. 6
b. 3
c. 2
d. 1
e. 4
f. 9
g. 5
h. 8
i. 7
j. 10

**Objective 15**

a. 2
b. 8
c. 1
d. 4
e. 5
f. 6
g. 7
h. 3

**Objective 16**

a, c, e

## Answers to Assignment Sheets

### Assignment Sheet 1

Evaluated according to the stated criteria. "No" answers indicate problems that should be discussed in the "Suggestions for Improvement" section.

### Assignment Sheet 2

Evaluated according to the stated criteria. "Often" and "Sometimes" indicate poor listening skills.

### Assignment Sheet 3

✔ **NOTE:** Answers to discussion questions will vary.

Situation 1

1. The purpose of the assignment is to present information including the rationale and technique of open gloving.
2. Answer should include assessing the material to be presented and the audience. Also may include planning visual support for the lecture and the mechanics of voice tone.
3. Any three of the following: be sincere and be aware of voice tone, fluency, articulation, and nonverbal communications.
4. No specific answer is given in the unit information. Answers may include: give a demonstration, use visual aids, etc.
5. Answer should include at least one of the following: listening for feedback, asking questions of the audience, asking for repeat demonstrations by members of the group, etc.
6. No specific answers are provided in the text except listening and evaluation of feedback.

Situation 2

1. The major goal of the assigned task is to solve the problem of which piece of equipment will be purchased.
2. a. Positive communication being demonstrated include smiling and relaxed tone between two of the surgeons.

   b. Negative communication is being demonstrated by the isolated surgeon with crossed legs and folded arms.
3. Any two of the following: finger tapping, cracking knuckles, wringing hands, tugging hair, moving around in chair if seated, clenching fist, folding arms, raising eyebrows, scowling, tightly pressed lips, shaking head from side to side, etc.

**Assignment Sheet 4**

Situation 1

a. Answer should include one of the following: Nature of the disease, possible disfigurement, possible prognosis.

b. Answer should relate to factor identified by the student and include one of the following: Asking open-ended questions, stating observations, giving information, validating, using silence, accepting, paraphrasing, and summarizing.

Situation 2

a. Security level (emotionally needs to know that family is ok)

b. Same answers as 1 b.

Situation 3—State observations, provide for patient needs (without overstepping care giver's responsibilities), and validate that the needs are met.

Situation 4—Physiological level (basic needs must be constantly assessed and met by the operating team)

Situation 5

a. NA. You should address the patient, not the father.

b. A. Using broad opening statements

c. NA. Reassuring clichés block communication and do not address the patient's anger and fears.

d. A. Using validating technique

e. NA. "Why" questions can intimidate and may seem accusatory. Rephrase like "I see you're shaking. Is there something I can do for you?"

Situation 6—Any two of the following: (Other answers are possible.)

a. Any direct communication with the patient will need to be on the child's level, both the physical level and the intellectual level. Use simple words and avoid "trigger" words that could scare the child such as "shots, needles, medicine, cut you, stick you," etc.

b. Because of the patient's age and the situation, the child will probably either not be able to or not want to talk to you. Therefore, verbal communication will primarily occur between you and the mother, and then between the mother and the child.

c. Nonverbal communication will be an important way to communicate with the young patient. Reassuring smiles and nods will help make the patient feel more comfortable.

d. The mother's apprehension about the surgery will be felt by the patient. If you address the mother's fears and questions, you will reassure her, which in turn will reassure the patient. The patient will calm down as the mother calms down.

Situation 7—A. Reduces language barrier; reassures patient

Situation 8—A. Reassures patient; makes she/he feel protected

Situation 9—NA. Many patients have a difficult time expressing themselves. The care giver should use general leads to help get them started or mention questions that other patients having similar procedures have asked to see if they will trigger any questions they might have.

Situation 10—Ask the surgeon to briefly explain what you have done or not done correctly. If it needs to be handled immediately, apologize and correct the work. If you do not agree that you have done something wrong, or if it can be corrected later, tell the surgeon you will be glad to discuss the problem after surgery is finished. You can't learn from your mistakes or do your job if you leave.

Introduction to Surgical Technology
Section A: Orientation to Surgical Technology
Module 2-A: Interpersonal Relationships and Communication Skills

## Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 7

1. What type of communication depends on the five basic senses?
   - a. nonverbal
   - b. oral
   - c. written
   - d. verbal

Objective 13

2. Which of the following is NOT true about effective communication for the patient undergoing surgery?
   - a. Communication is the continuum of patient care and teamwork among the staff.
   - b. Patients under the stress and anxiety of the upcoming surgery are better off not communicating their feelings or their emotional and physical needs to the health care team.
   - c. The surgical team must listen and observe what patients say and do.
   - d. Cultural and ethnic factors need to be considered when communicating with patients.

Objective 16

3. Which of the following demonstrates good communication while in surgery?
   - a. understanding signals and gestures
   - b. not allowing breaks in conversation to prevent awkward periods of silence
   - c. infrequent use of medical terminology
   - d. removing mask when one is not being properly understood

Objective 13

4. Effective communication can influence ______.
    a. the patient's behavior while in the operating room suite
    b. the patient's attitude toward surgery and health care workers
    c. the patient's behavior in the hospital following surgery
    d. all of the above

Objective 15

5. Which of the following is NOT true about using clichés?
    a. they reduce the patient's anxiety
    b. they reduce your anxiety
    c. they minimize the significance of the patient's feelings
    d. they send a message to the patient that you're not interested

Objective 10

6. Which of the following is a characteristic of a good communicator?
    a. dominates a conversation
    b. able to formulate a response while giving the impression of listening
    c. draws conclusions quickly and without wasting time
    d. focuses on the speaker

Objective 14

7. A patient says, "I wish I were dead." Which of the following is the most appropriate response?
    a. "This must be a very difficult time for you."
    b. "Oh, I know just how you feel. Why just yesterday, my head hurt so badly that I thought it would explode."
    c. "You poor thing. I'll get you a blanket."
    d. "You shouldn't feel that way. Millions of peole have the same problem."

Objective 7

8. What type of communication depends on the abilities to read, write, and see?
    a. nonverbal
    b. oral
    c. written
    d. verbal

Objective 15

9. ______ is an example of a block to therapeutic communication.

   a. Clarifying

   b. Paraphrasing

   c. Defending

   d. Selective reflecting

Objective 12

10. Which of the following is TRUE of inservice programs?

    a. are electronic record keeping software applications

    b. allow departments to communicate policy

    c. are methods of obtaining supplies

    d. present a doctor's surgical preferences

Objective 8

11. Because a patient's records are ______, miscommunication causing inaccurate information to be recorded on a patient's record can lead to lawsuits.

    a. legal documents

    b. forms of communication

    c. tools for doctors

    d. records for the patient's family

Objective 14

12. "Is there something you'd like to talk about?" is an example of ______.

    a. acknowledging the patient's feelings

    b. validating to make sure the patient's needs have been met

    c. using broad opening statements

    d. sharing observations with the patient

Objective 10

13. Paraphrasing what was heard ______.

    a. is considered rude in certain cultures

    b. helps to ensure that messages are properly received

    c. can be confusing to older patients

    d. prevents the patient from freely speaking their mind

Objective 6

14. Which of the following is NOT a goal of communication?

a. to express feelings
b. to solve problems through communication
c. to persuade others to change an attitude or behavior
d. to criticize the other person

Objective 12

15. Supply requests and doctor's preference cards are examples of what type of communication that enable other hospital departments to relate to the surgical suite?

a. records
b. verbal communication
c. requisitions
d. inservice programs

Objective 1

16. Which of the following is NOT a characteristic of a social relationship?

a. goal directed
b. may be casual or intimate, brief or longlasting
c. mutual
d. between peers

Objective 3

17. The ______ level of Maslow's hierarchy of human needs includes affection, love, acceptance, kindness, belonging, intimacy, and friendship.

a. physiological
b. security
c. social
d. ego

Objective 14

18. "You're shaking. You seem upset. Am I wrong?" is an example of ______.

a. acknowledging the patient's feelings
b. validating to make sure the patient's needs have been met
c. using broad opening statements
d. sharing observations with the patient

Objective 5

19. Which of the following is NOT a true statement about psychosocial stress?

    a. All patients react to their fears and anxiety in the same way.

    b. Stress may be especially acute among children.

    c. Elderly patients may experience disorientation, confusion, and depression, and may require extra care and patience.

    d. Children may experience stress because they lack the understanding of the complex surgical environment.

Objective 9

20. Which of the following is NOT an essential component of effective communication?

    a. sender

    b. message

    c. receiver

    d. feelings

Objective 15

21. Which of the following is NOT a block to communication?

    a. "You don't need to worry."

    b. "What you should do is..."

    c. "No, you are wrong."

    d. "Are you saying that..."

Objective 3

22. The ______ level of Maslow's hierarchy of human needs includes approval, recognition, prestige, and status from others because of an individual's actions.

    a. physiological

    b. security

    c. self-actualization

    d. ego

Objective 6

23. Communication is the process by which information is exchanged between individuals through a common system of words, symbols, signs, or ______.

    a. behavior

    b. feelings

    c. beliefs

    d. emotions

Objective 11

24. Which of the following is NOT one of the components of effective speaking?

   a. Determine what to say and how.
   b. Use feedback to see if the correct message was received.
   c. Listen only to verbal feedback.
   d. Determine purpose and audience.

Objective 7

25. ______ communication is sent in ways other than by words.

   a. Verbal
   b. Oral
   c. Nonverbal
   d. Written

Objective 4

26. Which of the following is NOT a positive way of coping with stress?

   a. imagery
   b. humor
   c. exercising
   d. shallow breathing

Objective 2

27. Relationships benefit from which of the following?

   a. speaking your mind at all times
   b. strong one-way communication
   c. constant laughter and joviality
   d. effective communication

Objective 1

28. A ______ relationship is guided by ethical code and policies of institution, along with common courtesy and good manners.

   a. social
   b. professional
   c. therapeutic
   d. confidential

Objective 5

29. Which of the following is an appropriate response to patient fear and anxiety?

   a. helping the patient with breathing techniques
   b. calling loved ones into the OR during difficult surgery
   c. deep massage of the patient's back by the surgical technologist
   d. hurrying the procedure

Objective 3

30. Which level of Maslow's hierarchy of needs is the most important for the surgical team to provide to the patient?

   a. emotional security
   b. correction of physiological problem
   c. feelings of kindness
   d. positive self-esteem

Objective 8

31. Which of the following is NOT a purpose of communication among hospital team members?

   a. to entertain each other during surgery
   b. to maintain accurate records
   c. to promote teamwork within the surgical environment
   d. to identify patient needs

Objective 4

32. ______ is a state of extreme difficulty, pressure, or strain that can cause bodily or mental tension.

   a. Fatigue
   b. Stress
   c. Anxiety
   d. Agitation

Objective 10

33. To listen effectively, focus on the ______, not the ______.

   a. feedback; message
   b. message; speaker
   c. verbal message; nonverbal message
   d. speaker; message

Objective 3

34. The correct order for Maslow's hierarchy of human needs from most basic to highest is:

    a. physiological, security, social, ego, self-actualization

    b. security, physiological, social, ego, self-actualization

    c. physiological, social, ego, self-actualization, security

    d. ego, security, physiological, social, self-actualization

Objective 1

35. A ______ relationship is between health care team members and the patient and the patient's family.

    a. social

    b. professional

    c. therapeutic

    d. confidential

*Permission to duplicate this module review is granted.

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## Answers to Module Review

1. a
2. b
3. a
4. d
5. a
6. d
7. a
8. c
9. c
10. b
11. a
12. c
13. b
14. d
15. c
16. a
17. c
18. d
19. a
20. d
21. d
22. d
23. a
24. c
25. c
26. d
27. d
28. b
29. a
30. b
31. a
32. b
33. b
34. a
35. c

# Introduction to Surgical Technology

## SECTION A:
## Orientation to Surgical Technology

### Module 3-A: Legal and Ethical Responsibilities

## Module Contents

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## Suggested Activities

**Instructional Plan**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**Preparation**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Review teacher supplement and make copies if it will be provided for each student.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**Delivery and Application**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**Evaluation**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module has two primary purposes: to introduce students to legal and ethical concepts involving medicine; and to provide a basis for evaluating legal and ethical conflicts while practicing surgical technology.

- Acquaint students with their legal responsibilities at local medical facilities by showing them copies of the facilities' policies and procedures manuals.
- Discuss and help students distinguish between the ethical obligations and the legal obligations of the surgical technologist.
- Invite an attorney with medical ethics or medical malpractice experience to talk to the class. Have the attorney discuss the following:
    - — Legal issues that could impact on the students' careers, any changes in the laws affecting surgical technologists, and how they can protect themselves.
    - — Liability insurance and whether or not the surgical technologist would need additional coverage over any provided by local medical facilities.
- Have students prepare questions beforehand to ask the attorney. After the presentation and discussion, have students summarize the attorney's main points.
- Arrange for students to observe a licensing board hearing for an RN or LPN. This activity can reinforce the idea of legal accountability.
- Discuss ways to show respect to patients in the following areas:
    - — Privacy
    - — Property
    - — Dignity (worthiness)
    - — Identity (individuality)
- Show a video dealing with ethical and/or legal issues facing medicine. Many of the videos in the "Suggested Supplemental Resources" are meant to trigger discussions. Students should examine their feelings about these sensitive issues before they are assigned to a case.

- Provide students with a short list of Internet sites dealing with legal and ethical issues. Refer to Suggested Web Sites at the end of the Suggested Activities section. For each site have each student write a brief description and state how it might help the surgical technologist research law, ethics, and standards of practice.

- Discuss historical figures who have contributed to the advancement of medicine. Refer to Teacher Supplement 1 for a listing of their names and contributions.

- Discuss famous people of today, such as heart surgeons and AIDS or virus researchers, who are making significant advancements in medicine. Discuss how their work can impact the surgical technologist. Research recent developments on the Internet.

- Give students a copy of the Hippocratic oath. Have them read it aloud together, and discuss what it means to them as a surgical technologist.

- Discuss recent incidents or legal court cases in which legal or ethical issues were in question. Without using real names, discuss how the incidents were handled, and what your class could learn from these cases.

- Present to the class scenarios involving different types of negligence. The scenarios may be real or made up. Ask the students to identify the type of negligence involved according to the definitions in Objective 2. To find legal cases involving negligence, consult Web sites that chronicle and track such court cases.

- Refer to Student Supplement 1 when discussing Objective 5.

- Discuss the complete version of the American Hospital Association's *Patient's Bill of Rights* with the students. Refer to Student Supplement 2. Ask the students to form groups and list *concrete* situations where a patient's right could be violated. For example, a doctor who discusses a patient's test results with a friend is violating the patient's right to privacy and confidentiality. You may wish to divide the document and assign different parts to each group.

- Invite a member of the AHA, a bioethicist, or a medical lawyer to discuss the most common legal and/or ethical situations that healthcare workers face in their occupations. Have the presenter talk about the importance of considering legal and/or ethical matters and ways that healthcare workers can be more aware of potential legal and ethical conflicts.

- For Assignment Sheet 2, you may wish to divide the class into teams, and then assign only certain cases to each group. This may save time and will allow the team members to interact, reinforcing teamwork skills. After the teams are finished, have them report back to the entire class with their results.

- For Assignment Sheet 2, take student responses anonymously and discuss with the class the legal and ethical implications of each answer.

- For Assignment Sheet 2, you will need to check with the school or local library to see what resources you can recommend to the students. You may wish to assign the ethical issues to ensure that all issues are covered. You may also assign teams to research an issue, with part of the team researching one side and the other team members researching the opposing side. When the students are finished researching and writing, this would be a good opportunity for a panel discussion or debate. Although debates on ethics can get heated, stress to students that these same issues will come up when they are employed as surgical technologists, and it is helpful to have already discussed these issues and seen that every issue has two sides.

## RESOURCES USED IN DEVELOPING THIS MODULE

### Books

- Allmers, Nancy M., and Joan Ann Verderame. *Appleton & Lange's Review for the Surgical Technology Examination*. 4th ed. New York: McGraw-Hill/Appleton & Lange, 1996.
- *AORN Standards, Recommended Practices & Guidelines*. Denver: Association of Operating Room Nurses, Inc., 2001.
- Caruthers, Bob L., and Paul Price, ed. *Surgical Technology for the Surgical Technologist—A Positive Care Approach*. Albany, NY: Delmar, 2001.
- *Code of Ethics*. Littleton, CO: Association of Surgical Technologists.
- Fairchild, Susan S. *Perioperative Nursing Principles and Practice*. 2nd ed. Philadelphia: Little, Brown and Company, Inc., 1996.
- Fortunato, Nancymarie. *Berry and Kohn's Operating Room Technique*. 9th ed. St. Louis: Mosby, Inc., 2000.
- Fuller, Joanna R. *Surgical Technology—Principles and Practice*. 3rd ed. Philadelphia: W. B. Saunders Co., 1994.
- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1994.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery*. 11th ed. St. Louis: Mosby, Inc., 1999.
- *Practical Nursing Series—Nursing Concepts*. Stillwater, OK: Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1998.

### Pamphlets

- *Competency Statements for the Surgical Technologist*. Littleton, CO: Association of Surgical Technologists, Inc.
- *An Introduction to the Association of Surgical Technologists*. Littleton, CO: Association of Surgical Technologists, Inc.
- *Job Description: Certified Surgical Technologist*. Littleton, CO: Association of Surgical Technologists, Inc.
- *A Profile of the Surgical Technologist*. Littleton, CO: Association of Surgical Technologists, Inc.
- *Surgical Technologist and First Assistant National Certifying Examinations—Candidate Handbook*. Englewood, CO: Liaison Council on Certification for the Surgical Technologist (LCC-ST), 1999.

### Magazine Article

- Netzel, Lizabeth. "The Meaning of Certification—Then and Now." *The Surgical Technologist* (December 1995): 25-27.

**Web Sites**

- http://www.aha.org/resource/pbillofrights.asp

  *A Patient's Bill of Rights.* Retrieved December 19, 2001, from American Hospital Association.

- www.ast.org

  Association of Surgical Technologists, Inc.

SUGGESTED SUPPLEMENTAL RESOURCES

- *Patient Rights: The Art of Caring.* 18-minute videotape showing the Patient's Bill of Rights in hospital vignettes.
- *Advance Directives: Guidelines for Health Care Providers.* 15-minute videotape presenting an overview of advance directives, legal implications, and patient considerations.

Available from:

Medcom, Inc.
6060 Phyllis Drive
Cypress, CA 90630
800-877-1443
www.medcominc.com

- *Decisions of the Heart.* 8-minute videotape that addresses the decision of whether or not to resuscitate and what that involves.

Available from:

American Journal of Nursing Company
Educational Services Division
555 West 57th Street
New York, NY 10019-2961
800-256-4045

- *The Courage of One's Convictions.* 15-minute videotape about a 17-year-old girl who refuses treatment because of religious convictions.
- *Critical Choice.* 15-minute videotape about a hospital director who must choose between a liver transplant needed to save a child or funding a new program that could prevent 30 infants from dying within the next year.
- *If You Want a Girl Like Me.* 13-minute videotape about a teenage mother refusing life-saving treatment for her newborn suffering from spina bifida and hydrocephalus.
- *The Old Person's Friend.* 13-minute videotape about the dilemma of whether to allow an elderly woman to die as she seems to wish, or to give her antibiotics to preserve her life.
- *Who Should Decide.* 13-minute videotape about parents deciding whether or not to terminate a pregnancy when they discover their unborn child has spina bifida, the same disease as the mother.

The four videos listed onthe previous page are available from:

Pyramid Film and Video
P.O. Box 1048
Santa Monica, CA 90406-1048
800-421-2304

- *Living Wills.* 30-minute videotape that examines the concept of living wills and advanced directives.
- *The Right to Die.* 28-minute videotape which addresses the question: Do dying patients have the right to die, or is it the obligation of society and the medical profession to keep patients legally alive as long as possible? Specially adapted from a Phil Donahue program.
- *Medicine and Mercy.* 26-minute videotape that looks at both sides of the issue of ceasing artificial life-support systems.

Available from:

Films for the Humanities, Inc.
Box 2053
Princeton, NJ 08543-2053
800-257-5126 or 609-452-1128

- *Ethical Dilemmas in Perioperative Nursing.* 1995. 19-minute video describes ethical principles and provides a framework for resolving ethical dilemmas.

Available from:

Ciné-Med, Inc.
127 Main Street North
Woodbury, CT 06798
800-253-7657
www.cine-med.com

**SUGGESTED WEB SITES***

- American Hospital Association — http://www.aha.com

  This site is the official Internet address of the American Hospital Association. The site contains the Patient's Bill of Rights and a recommended code of ethics for hospitals as well as reference information for medical law, recent medical news, articles, books, journals, and other Internet sites.

- Dr. Witherspoon — http://www.drwitherspoon.com

  This site contains examples of medical malpractice taken from the news and offers an opinion on how the incident could have been avoided.

- Health Care Practice — http://www.healthcarepractice.com/

  This site provides links for researching medical law and the latest medical news.

- Health Law Resource — http://netreach.net/~wmanning/

  This site is intended to be a resource for healthcare professionals and patients and provides information for researching medical news and federal and state health care law.

- 'Lectric Law Library Medical Topic Area — http://www.lectlaw.com/tmed.html

  This site provides information and news concerning medical malpractice, litigation, and standards of care. The site also contains an index of medical terms.

- Surgery 101 — http://www.surgery101.com

  This site contains information about surgical procedures and links to recent medical news about litigation and ethics.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

## Teacher Supplement 1—Individuals Who Contributed to the Advancement of Medicine and Surgery

- Hippocrates (460-377 B. C. approximately)—Greek physician considered the "Father of Medicine"; his oath is still used in medical schools today
- Galen (130-200 A.D.)—Greek physician and writer whose writings (along with Hippocrates') were the authority of medicine for many centuries; upheld high standards of technique for his time
- Andreas Vesalius (1514-1564)—Belgian anatomist and artist who is considered the "Chief Founder of the Modern Study of Anatomy" because of his animal experiments and dissections on human cadavers
- William Harvey (1578-1657)—English physician and anatomist who discovered the circulation of blood but did not know how blood got from arteries to veins (through capillaries)
- Ambriose Paré—French army surgeon in the 16th century who revived the use of ligatures to control hemorrhage
- Marcello Malpighi (1628-1694)—Italian anatomist who first discovered capillaries, and is known as the "Father of Histology" (the study of tissues in detail)
- Anton van Leeuwenhoek (1632-1723)—Dutch merchant who made simple microscopes and first saw microorganisms through them
- Giovanni Battista Morgagni (1682-1771)—Italian anatomist who is known as the "Founder of Pathologic Anatomy"

  ✔ **NOTE:** Many structures of the body are named after him such as the "cyst of Morgagni."

- Oliver Wendell Holmes, Sr. (1809-1894)—American physician and author who coined the term "anesthesia" which literally means "without sensation or feeling"; in 1843 wrote of the contagious nature of puerperal (childbed) fever, and expressed the belief that it was carried by nurses and doctors from patient to patient
- Ignaz Semmelweis (1818-1865)—Austrian physician who established the true cause of puerperal fever, and required the doctors and medical students on his wards to wash their hands in chlorinated lime solution before examining patients
- Crawford Long (1815-1878)—American surgeon from Athens, Georgia who first discovered and used ether in Macon General Hospital to remove small skin tumors from his patients, but he did not publish his results until 1849
- William Morton (1819-1868)—American dentist from Boston who in 1846 gave the first **public** demonstration of the use of ether as an anesthetic agent

  ✔ **NOTE:** This brought ether into use for surgical operations.

- Louis Pasteur (1822-1895)—French chemist who greatly contributed to bacteriology and immunology, developed technique for immunization, and founded science of microbiology

  ✔ **NOTE:** In his work with wine, he showed that wine's fermentation was due to minute organisms, whose growth could be controlled by using heat. Thus, he developed the process of pasteurization, named after him.

- Joseph Lister (1827-1912)—English surgeon who promoted the importance of cleanliness to prevent surgical wound infections; called the "Father of Modern Antiseptic Surgery"

- Robert Koch (1843-1910)—German bacteriologist who developed postulates (criteria) for proving whether or not an organism is the cause of a disease; known as the "Father of Immunology"

- Willhelm Roentgen (1845-1923)—German physicist who discovered X rays or Roentgen rays in 1895

- William Halsted (1852-1922)—American surgeon who taught at Johns Hopkins Hospital in Baltimore from 1893-1922; perfected and brought into use many techniques which are still in use today. Among this most famous inventions, procedures, and techniques are:

  - Perfecting a fine-pointed hemostat for clamping bleeding vessels
  - Advocating excellent principles of tissue handling
  - Developing an interrupted silk-suture closure technique
  - Wearing rubber gloves

- Marie Curie (1867-1934)--Polish-French physicist and chemist who isolated the element radium as a metallic substance

- Harvey Cushing (1869-1939)—American surgeon who made many contributions to neurosurgery, including introducing silver clips for hemostasis, describing the relationship between intracranial pressure and blood pressure, and discussing pituitary basophilism (Cushing's disease); known as the "Father of Modern Neurosurgery"

- W. T. Bovie—American physicist who developed the first spark-gap tube generator in the 1920s which was the universal basis of electrosurgical units until the 1970s when solid-state units became available

# Introduction to Surgical Technology
# Section A: Orientation to Surgical Technology
# Module 3-A: Legal and Ethical Responsibilities

## Written Test

Name ________________________________________

Date ____________________ Score ____________________

**OBJECTIVE 1**

Discuss accountability for personal actions and obligations. Write your answers on the blank lines provided below.

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

**OBJECTIVE 2**

Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions. Write the numbers on the blanks provided and on the following pages.

_______ a. The state of being answerable or responsible; being legally bound, as to make good any loss or damage that occurs in a transaction

_______ b. A violation of the obligation to keep a patient's records and confidences private

_______ c. An injury induced by a doctor or care giver

_______ d. The degree of negligence in which each of the parties involved may be shown to have been responsible for the injury caused

_______ e. Literally, "a superior (or master) must answer"; employers are responsible for the acts and omissions of their employees

_______ f. The expectation that an individual may be called to account for actions taken that were consistent with responsibilities contracted by virtue of employment or learner experience

_______ g. Wrongs of slander and libel

_______ h. Law established on the basis of previous court decisions

1. Accountability
2. Breach of confidentiality
3. Common law
4. Comparative negligence
5. Defamation
6. Iatrogenic injury
7. Liability
8. Respondeat superior

_______ i. Literally, "a thing that speaks for itself"; a defendant is guilty of negligence without the need to show their direct involvement; its use is limited to cases in which the cause of a plaintiff's injury was entirely under the control of the defendant, and presumably the injury could have been caused only by negligence

_______ j. A serious crime punishable by law with penalties ranging from imprisonment to death

_______ k. A written defamation of character; an untruthful written statement about a person that subjects that person to ridicule or contempt

_______ l. A statement made to a lawyer, physician, or member of the clergy in confidence and implicitly understood that it shall remain a secret

_______ m. A private or civil wrong or injury for which the court provides a remedy through an action for damages

_______ n. Literally, "the patient first"; the motto of the Association of Surgical Technologists

_______ o. Legally valid document written in advance of serious illness that state a patient's choices for health care, or names a second party to make those choices if the patient becomes unable to make decisions

_______ p. The state of being legally responsible for one's actions

_______ q. A person accused of a tort or crime who is required to make answer in a legal action or suit

_______ r. Being unqualified or inadequate to perform a duty or duties

_______ s. One who commences a legal action or suit to obtain a remedy for an injury to his/her rights; the complaining party

_______ t. The right of a patient to expect that professional and technical personnel will perform their duties and meet the standards of other reasonable, prudent, and honest personnel involved in similar circumstances

_______ u. A legal process charging a party with a wrong done or a crime committed

9. Advance directive
10. Aeger primo
11. Complaint
12. Confidential communication
13. Defendant
14. Doctrine of reasonable man
15. Felony
16. Incompetence
17. Libel
18. Personal liability
19. Plaintiff
20. Res ipsa loquitur
21. Tort

_______ v. Failure to use care that a reasonable and prudent person would use under similar circumstances

_______ w. Any professional misconduct resulting in harm to another

_______ x. Testimony of a witness or a party taken under oath outside the courtroom, the transcript of which becomes part of the court's file

_______ y. An illegal act against society

_______ z. Literally, "first, do no harm"; a guiding principle of the Hippocratic medical ethics

_______ aa. A spoken defamation of character; an untruthful oral statement about a person that subjects that person to ridicule or contempt

_______ bb. The supervisor, instructor, or physician is absent while the surgical technologist is performing their responsibilities, or the supervisor, instructor, or physician is not near enough to the technologist to give assistance

_______ cc. Unlawful threat to harm another physically

_______ dd. An act or omission that is the result of actual conscious indifference to rights, safety, or welfare of persons

_______ ee. Law enacted by Congress and state legislatures

_______ ff. A wrong that violates a person's right to be free from unauthorized intrusion

_______ gg. A lawsuit

_______ hh. A person having special training or experience who assists a judge and jury in their decision-making process

_______ ii. The carrying out of physically-threatened harm

_______ jj. The state of being legally responsible for the company's actions

_______ kk. A crime of lesser offense than a felony, punishable by fines and/or imprisonment, usually for less than one year

_______ ll. Legal liability of manufacturers and sellers to compensate buyers, users, or others for damages or injuries caused by defects in their products

22. Assault
23. Battery
24. Corporate liability
25. Crime
26. Deposition
27. Expert witness
28. Gross/criminal negligence
29. Invasion of privacy
30. Lack of proper supervision
31. Litigation
32. Malpractice
33. Misdemeanor
34. Negligence
35. Primum non nocere
36. Product liability
37. Slander
38. Statutory law

**OBJECTIVE 3** List ten operating room incidents that could result in litigation. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

**OBJECTIVE 4** Define criteria used to establish negligence in court cases involving the surgical team. Write your answers on the blank lines provided below.

a. Damage ______________________________

b. Dereliction/failure to meet standard ______________________________

c. Foreseeability of harm ______________________________

d. Proximate (direct) cause of injury or damage ______________________________

e. Standard of due care ______________________________

**OBJECTIVE 5** Match terms related to credentialing to their correct definitions. Write the numbers on the blanks provided below.

_______ a. The granting of licenses to practice a profession; ensures that individual is qualified and has met certain educational and training standards

_______ b. Documentation that confirms that one has met the requirements of and may practice in a field

_______ c. The process of establishing a minimum level of skills and knowledge for a professional activity

_______ d. The formal recognition of an instructional program as conforming with a set of standards

_______ e. The act of listing qualified individuals in a registry

1. Accreditation
2. Certification
3. Credentialing
4. Licensure
5. Registration

**OBJECTIVE 6** Discuss surgical conscience. Write your answer on the blank lines provided below.

________________________________________________

________________________________________________

________________________________________________

________________________________________________

**OBJECTIVE 7** Complete statements concerning ethics. Write your answers on the blank lines provided in the statements below and on the next page.

a. Ethics are influenced by _______________, _______________, and _______________ backgrounds as well as life experiences.

b. Ethics should govern professional _______________.

c. Ethics and _______________ are closely related because _______________ doctrines often interpret ethical concepts.

d. Principles of ethical decision-making in clinical practice include:

  - _______________ is the right of the individual to trust that his/her dignity, privacy, and confidentiality will be protected.
  - _______________ is the duty to do no harm.

- ________________ refers to an individual's freedom of choice and their right to make decisions that determine a course of action.
- ________________ is the duty to assist others in determining their best interest.
- ________________ is the distribution of resources a person has the right to receive or claim.

**OBJECTIVE 8** List eight ways of making ethical decisions as a surgical technologist. Write your answers on the blank lines provided below.

a. ________________

b. ________________

c. ________________

d. ________________

e. ________________

f. ________________

g. ________________

h. ________________

**OBJECTIVE 9** List three resources that may help a surgical technologist interpret and follow professional standards of conduct. Write your answers on the blank lines provided below.

a. ________________

b. ________________

c. ________________

**OBJECTIVE 10** List eight items in the surgical technologist's code of ethics. Write your answers on the blank lines provided below and on the next page.

a. ________________

b. ________________

c. ________________

d. ________________

e. ________________

f. ________________

g. ____________________

h. ____________________

**OBJECTIVE 11** Complete statements concerning standards of professional practice. Write your answers on the blank lines provided in the statements below.

a. Standards of professional practice describe activities related to ______________, ______________, ______________, and ______________.

b. Standards are set and maintained by each medical facility to provide guidelines for patient ______________ and ______________.

c. Personnel must adhere to established policies and procedures to protect themselves, other workers, and the medical facility from ______________.

d. ______________ is essential for perioperative care and contingent upon interpersonal skills.

e. Preoperative planning and preparation for surgical intervention are ______________ to meet the needs of the patient and surgeon.

f. Preparation of the surgical suite/clinical area and all supplies and equipment will ensure ______________ safety for patients and personnel.

g. Application of basic and current ______________ is necessary for a proficient performance of assigned functions.

h. Each patient's rights to ______________, ______________, safety, and ______________ are respected and protected.

i. Every patient is entitled to the same application of ______________ techniques within the physical facilities.

**Objective 12**

Select true statements concerning the Patient's Bill of Rights. Write a "T" on the blanks provided next to the true statements below.

_______ a. The patient has the right to obtain information about any relationship of the involved hospital to other health care and educational institutions, regardless if it pertains to patient's care or not.

_______ b. The patient has the right to obtain from the physician complete current information concerning diagnosis, treatment, and prognosis.

_______ c. The patient has the right to expect that all communications and records will be treated as confidential by the hospital to the extent permitted by law.

_______ d. The patient has the right to set up an advance directive.

_______ e. The patient has the right to a limited consideration of privacy concerning case discussion, consultation, examination, and treatment.

_______ f. The patient has the right to receive from the physician information about the physician's medical practice and history.

_______ g. The patient has the right to be informed of hospital resources for resolving grievances.

_______ h. The patient has the right to expect a hospital regardless of its capacity to make response to a patient's request for services.

_______ i. The patient has the right to immediate care.

_______ j. The patient has the right to refuse to participate in human experimentation requiring direct patient involvement.

_______ k. The patient has the right to expect reasonable continuity of care.

_______ l. The patient has the right to access records pertaining to the patient's medical care and to have the information explained except when restricted by law.

***Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1**

Discussion should include the following points.

a. Within our society, people are legally accountable for actions taken in their personal and professional lives. When they deny their obligations, they can be held responsible and face lawsuits that result in financial restitution, imprisonment, and/or other actions.

b. Surgical technologists have legal and ethical responsibilities toward their patients.

c. Surgical technologists, their employers, and members of the surgical team can be held responsible for negligence for actions taken or not taken in the healthcare environment.

d. Surgical technologists must adhere to accepted standards, regulations, policies, and laws.

e. Surgical technologists are obligated to disclose details of their patient care and surgical procedure activities in written documentation and when called upon in legal proceedings.

**OBJECTIVE 2**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| a. | 7 | i. | 20 | q. | 13 | y. | 25 | gg. | 31 |
| b. | 2 | j. | 15 | r. | 16 | z. | 35 | hh. | 27 |
| c. | 6 | k. | 17 | s. | 19 | aa. | 37 | ii. | 23 |
| d. | 4 | l. | 12 | t. | 14 | bb. | 30 | jj. | 24 |
| e. | 8 | m. | 21 | u. | 11 | cc. | 22 | kk. | 33 |
| f. | 1 | n. | 10 | v. | 34 | dd. | 28 | ll. | 36 |
| g. | 5 | o. | 9 | w. | 32 | ee. | 38 | | |
| h. | 3 | p. | 18 | x. | 26 | ff. | 29 | | |

**OBJECTIVE 3**

Answers should include any ten of the following. Answers may appear in any order.

a. Abandonment
b. Assault and battery
c. Breach of confidentiality
d. Burns, falls, or injuries
e. Defamation
f. Documentation errors
g. Exceeding authority or accepted functions
h. Failure to observe critical events and to take appropriate action
i. Improper care of patient's property (including loss or damage)
j. Improper care of specimens (including loss or misidentification)
k. Incorrect drugs or incorrect administration
l. Incorrect positioning
m. Incorrect procedure
n. Incorrect sponge, needle, or instrument counts
o. Invasion of privacy
p. Lack of informed consent
q. Major break in aseptic technique
r. Misidentification of patient
s. Use of defective equipment or instruments

**Objective 4**

a. The loss caused by one person to another or to their property, either with the design of injuring him, with negligence and carelessness, or by inevitable accident; the loss that someone has sustained and the gain which he has failed to make

b. Willful neglect of the standard of action in a particular situation

c. The degree to which an action could be anticipated to cause injury; a key issue in determining a person's liability

d. When an action plays any part, no matter how small, in bringing about the injury or damage

e. Criterion used by general agreement to denote an acceptable level of practice or an established norm; standards of care establish a basic model which measures the quality of practice

**Objective 5**

a. 4
b. 2
c. 3
d. 1
e. 5

**Objective 6**

Discussion should include the following points.

- Protect patients from physical hazards in the operating room
- Understand the patient's fears and anxieties concerning surgery
- Act in a conscientious manner
- Maintain professional honesty in actions as well as capabilities and qualifications
- Maintain aseptic technique
- Strive to contain costs
- Treat patient information confidentially by respecting the patient's rights to privacy, property, dignity, and identity
- Treat patients in a nondiscriminatory manner

**Objective 7**

a. cultural; socio-economic; religious
b. conduct
c. laws; legal
d.
  - Fidelity
  - Nonmaleficence
  - Autonomy
  - Beneficence
  - Justice

**OBJECTIVE 8** Answers should include any eight of the following. Answers may appear in any order.

a. Identify the moral aspects of care
b. Gather relevant facts related to a moral issue
c. Clarify and apply personal values
d. Understand ethical theories and principles
e. Utilize competent interdisciplinary resources
f. Propose alternative actions
g. Apply codes of ethics to help guide actions
h. Choose and act on resolutive action
i. Participate actively in resolving issues
j. Apply state/federal laws governing practice
k. Evaluate the resolutive action to be taken

**OBJECTIVE 9** Answers should include any three of the following. Answers may appear in any order.

a. Continuing education
b. Colleagues and experienced health care professionals
c. Medical journals
d. World Wide Web

**OBJECTIVE 10** Answers should include any eight of the following. Answers may appear in any order.

a. To maintain the highest standards of professional conduct and patient care
b. To hold in confidence, with respect to the patient's beliefs, all personal matters
c. To respect and protect the patient's legal and moral rights to quality patient care
d. To not knowingly cause injury or any injustice to those entrusted to our care
e. To work with fellow technologists and other professional health groups to promote harmony and unity for better patient care
f. To always follow the principles of asepsis
g. To maintain a high degree of efficiency through continuing education
h. To maintain and practice surgical technology willingly, with pride and dignity
i. To report any unethical conduct or practice to the proper authority
j. To adhere to the code of ethics at all times with all members of the health care team

**OBJECTIVE 11**

a. quality assurance; education; ethical behavior; accountability
b. care; safety
c. litigation
d. Teamwork
e. individualized
f. environmental
g. knowledge
h. privacy; dignity; comfort
i. aseptic

**OBJECTIVE 12** b, c, d, g, j, k, l

## Answers to Assignment Sheets

**Assignment Sheet 1**

Answers will vary and must be evaluated to the satisfaction of the instructor.

**Assignment Sheet 2**

Answers will vary and must be evaluated to the satisfaction of the instructor.

## Module Review

Name ______________________________

Date ______________________ Score ______________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 4

1. The loss caused by one person to another or to their property, either with the design of injuring him, with negligence and carelessness, or by inevitable accident is ______.
   a. damage
   b. foreseeability of harm
   c. dereliction/failure to meet standard
   d. proximate cause of injury or damage

Objective 2

2. The motto of the AST is ______.
   a. res ipsa loquitur
   b. aeger primo
   c. primum non nocere
   d. respondeat superior

Objective 12

3. The Patient's Bill of Rights was adopted by the American Hospital Association in ______ and later modified in ______.
   a. 1972; 1992
   b. 1973; 1992
   c. 1972; 1993
   d. 1973; 1993

Objective 2

4. Which of the following types of law is established on the basis of previous court decisions?

   a. corporate law

   b. statutory law

   c. tort law

   d. common law

Objective 11

5. Which of the following is NOT a standard of practice followed by surgical technologists?

   a. Preoperative planning and preparation for surgical intervention are generalized to meet the needs of the largest numbers of patients and surgeons.

   b. Preparation of the surgical suite/clinical area and all supplies and equipment will ensure environmental safety for patients and personnel.

   c. Application of basic and current knowledge is necessary for a proficient performance of assigned functions.

   d. Every patient is entitled to the same application of asepsis techniques within the physical facilities.

Objective 6

6. Which of the following is NOT an attribute of surgical conscience?

   a. completely eliminate the patient's fears and anxieties concerning surgery

   b. protect the patient from physical hazards in the operating room

   c. respect the patient's rights to privacy, property, dignity, and identity

   d. treat patients in a nondiscriminatory manner

Objective 2

7. A(n) ______ injury is an injury that was induced by a doctor or caregiver.

   a. accidental

   b. iatrogenic

   c. premeditated

   d. negligent

Objective 5

8. ______ is the formal recognition of an instructional program as conforming with a set of standards.

   a. Accreditation

   b. Credentialing

   c. Certification

   d. Licensure

Objective 10

9. Which of the following is NOT part of the surgical technologist's code of ethics?

   a. to maintain the minimum standards of professional conduct and patient care

   b. to maintain the highest standards of professional conduct and patient care

   c. to respect and protect the patient's legal and moral rights to quality patient care

   d. to report any unethical conduct or practice to the proper authority

Objective 3

10. Which of the following incidents are UNLIKELY to result in litigation?

    a. use of defective equipment or instruments

    b. rigorous effort to maintain aseptic technique

    c. improper care of specimens

    d. failure to observe critical events and take appropriate action

Objective 12

11. The Patient's Bill of Rights includes which of the following?

    a. the right to immediate and cost-efficient care

    b. the right to refuse to participate in human experimentation requiring direct patient involvement

    c. the right to review all medical records that demonstrate a surgeon's abilities

    d. the right to review all hospital records in the hospital's history of patient care

Objective 4

12. The degree to which an action could be anticipated to cause injury is ______.

    a. damage

    b. foreseeability of harm

    c. dereliction/failure to meet standard

    d. proximate cause of injury or damage

Objective 1

13. Which of the following is NOT a true statement about a surgical technologist's accountability for their personal actions and obligations?

    a. Surgical technologists should never disclose details of their patient care and surgical procedure activities, not even in legal proceedings.

    b. Surgical technologists can be held responsible for negligence for actions taken or not taken in the healthcare environment.

    c. Surgical technologists must adhere to accepted standards, regulations, policies, and laws.

    d. Surgical technologists have legal and ethical responsibilities toward their patients.

Objective 5

14. What organization verifies that educational programs for surgical technology have met minimum standards?

    a. Commission on Accreditation of Allied Health Education Programs (CAAHEP)

    b. Liaison Council on Certification for the Surgical Technologist (LCC-ST)

    c. Association of Surgical Technologists (AST)

    d. Joint Commission on Accreditation of Healthcare Organizations (JCAHO)

Objective 2

15. Which of the following is defined as any professional misconduct resulting in harm to another?

    a. negligence

    b. incompetence

    c. malpractice

    d. liability

Objective 5

16. ______ is voluntary and confirms that one has met the requirements of and may practice in a field.

    a. Accreditation

    b. Credentialing

    c. Certification

    d. Licensure

Objective 2

17. ______ is an unlawful threat to harm another physically.

    a. Battery
    b. Liability
    c. Personal liability
    d. Assault

Objective 8

18. Which of the following is NOT a method of making ethical decisions as a surgical technologist?

    a. apply codes of ethics to help guide actions
    b. apply state/federal laws governing practice
    c. evaluate resolutive actions to be taken
    d. refuse to participate in resolving issues

Objective 9

19. Which of the following is NOT a resource that may help a surgical technologist interpret and follow professional standards of conduct?

    a. colleagues and experienced health care professionals
    b. medical journals
    c. Web sites containing invalid information
    d. continuing education

Objective 7

20. An individual's freedom of choice and their right to make decisions that determine a course of action is called ______.

    a. capability
    b. autonomy
    c. beneficence
    d. fidelity

Objective 11

21. Who sets and maintains standards that provide guidelines for patient care and safety?

    a. surgical technologist
    b. surgeon
    c. medical facility
    d. registered nurse

Objective 7

22. Ethics and laws are closely related because ______.

a. both ethics and laws are interpreted by religion
b. ethical doctrines and legal concepts are the same
c. ethical doctrines often interpret legal concepts
d. legal doctrines often interpret ethical concepts

Objective 6

23. Which of the following IS an attribute of surgical conscience?

a. act in accordance with your own religious beliefs
b. adjust costs to patient's economic condition
c. act in a conscientious manner
d. disregard patient's fears and anxieties concerning surgery

Objective 8

24. Which of the following is NOT a method of making ethical decisions as a surgical technologist?

a. clarify and apply personal values
b. impose religious ideals
c. propose alternative actions
d. understand ethical theories and principles

Objective 7

25. Which of the following is NOT a principle of ethical decision making in clinical practice?

a. capability
b. autonomy
c. beneficence
d. fidelity

Objective 2

26. Which of the following is the guiding principle of the Hippocratic medical ethics?

a. res ipsa loquitur
b. aeger primo
c. primum non nocere
d. respondeat superior

Objective 7

27. Ethics are NOT influenced by which of the following?
    a. occupation
    b. culture
    c. religion
    d. life experience

Objective 2

28. The doctrine that states that employers are responsible for the acts and omissions of their employees when done within the scope of the employees' duties is called ______.
    a. respondeat superior
    b. res ipsa loquitur
    c. primum non nocere
    d. doctrine of reasonable man

Objective 4

29. Which of the following is NOT a criteria used to establish negligence in court cases involving the surgical team?
    a. damage
    b. foreseeability of harm
    c. dereliction/failure to meet standard
    d. indirect cause of injury or damage

Objective 2

30. A living will, health care proxy, and power of attorney are examples of ______.
    a. commissions
    b. depositions
    c. advance directives
    d. testimony

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. a
2. b
3. b
4. d
5. a
6. a
7. b
8. a
9. a
10. b
11. b
12. b
13. a
14. a
15. c
16. c
17. d
18. d
19. c
20. b
21. c
22. d
23. c
24. b
25. a
26. c
27. a
28. a
29. d
30. c

# Introduction to Surgical Technology

## SECTION B:
## Safety

### Module 1-B: Environmental Safety

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Gather the following equipment and materials to aid you in illustrating and demonstrating your classroom presentation:
    - Enough copies of the organization's accident report form for each student in the class
    - Set of standard and surgical PPE (gloves, eye protection, head cover, booties, etc.)
    - Organization's Policies and Procedures manual
    - Examples of the organization's lockout devices and tag-out tags
    - An example of—or the location of—an NFPA hazard diamond
    - Full-color sheet illustrating DOT hazardous material placards
    - Enough copies of one of the organization's MSDSs for each student in the class
    - Large carton of books or other heavy object for lifting demonstration
    - Telephone for role-playing the receipt of a bomb threat
    - Organization's emergency disaster supply kit
    - Organization's posted fire and evacuation routes
    - Variety of portable fire extinguishers

      ✔ **NOTE:** Job Sheet 2 should be taught/supervised by a representative from the fire department. This person will probably be able to supply you with a variety of portable extinguishers.
    - Examples of—or the location of—various plugs, extension cords, electrical outlets, junction boxes, and electrical panels
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.

- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.
- Discuss and demonstrate the job sheets. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of these activities and the rating scale that will be used to indicate job performance.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Evaluate the job sheets. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided on the next page. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

**Sample A**

4—**Skilled**—Can perform job with no additional training.
3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
1—**Unskilled**—Is familiar with process, but is unable to perform job.
0—**No exposure**—No information or practice provided during training program.

**Sample B**

**Yes**—Can perform job with no additional training.
**No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

- Have students and parents/guardians complete the safety pledge in Assignment Sheet 1.
- Objective 1 and Objective 2 focus on developing good safety habits. Discuss ways of developing a good safety attitude. Ask students to provide you with specific examples of times in which their unsafe attitude caused an injury or accident. Through your discussion, elicit from the students the specific causes for these injuries and accidents.
- Read aloud or have students read aloud each of the safety guidelines in Objective 2. After you or the students read each guideline, provide the school/organization information required in the guideline.
    - Ask students if they know the area numbers for fire, police, poison control, ambulance service, etc. Review these numbers with the students and show students these numbers posted near the telephone.
    - Show the students the location of all posted safety rules and signs. Read and explain these signs.
    - Take students on a brief tour of the building or floor, showing them the location of fire alarms, fire extinguishers, and first-aid equipment.
    - Have available a complete set of standard and surgical PPE (various eye protection, gloves, respirators, booties, head cover, etc.). Show students the correct way to don each article of PPE, and allow them to return your demonstration.
    - Ensure that each student has a copy of the organization's policies and procedures manual. Review the specific safety guidelines in it.
    - Assign Assignment Sheet 2 to be completed in class or by a specified date. Provide students with copies of your facility's accident reporting form.

- When teaching Objective 3, show students examples of the organization's lockout devices and tag-out tags. Explain where these materials are located and the organization's policies on their use. Demonstrate how to complete the tags and how to use the lockout locks and keys. Allow each student to demonstrate competency in completing a tag and locking out a piece of equipment.

- Objective 4 lists expectations for a safe environment at school or work. Have the class objectively review the list and analyze their school or work environment to see whether it meets these expectations. Does their school or place of work provide adequate lighting, clean air, clearly identified hazardous materials, lighted, open parking, and so forth?

- Objective 5 through Objective 9 cover hazardous materials symbols, labeling, and MSDS. Before covering these objectives, provide students with copies of one of the organization's MSDSs and refer them to Student Supplement 1 in their student editions.

  — Review the purposes of an MSDS listed in Objective 5.

  — Review the typical sections of an MSDS listed in Objective 6. Explain that while each MSDS differs in format from organization to organization, each must contain the eight basic sections listed in Objective 6.

  — Have students compare their organization's MSDS with the sample MSDS in Student Supplement 1.

  — Ensure that students are familiar with and understand the terms *flashpoint, combustible, flammable,* and *reactivity*, found on MSDSs.

  — When teaching Objective 7, review the symbols on various hazard placards. Use Transparency Master 1, DOT Hazard Placards, to illustrate your discussion.

  — Take students on a tour of the organization, pointing out the symbols on various posted hazardous materials safety signs and placards. Have students note the color and design of the placard as well as the hazard symbol on it. Storage and power generating areas are good places to find such placards, as well as hospital labs, morgues, pharmacies, and x-ray departments. If you do not have access to such areas, show students full-color illustrations of the placards.

  — When teaching Objective 8, use Transparency Master 2 to illustrate your explanation. Stress the importance of the colors and numbers on the NFPA 704 hazard diamond. Try to find a posted NFPA 704 hazard diamond so that students can practice decoding it. Use also the NFPA 704 diamond on the Industrial Formula Drano MSDS in Assignment Sheet 3.

  — In teaching Objective 9, discuss the methods by which hazardous materials can enter the body, providing specific examples and reviewing the Health Hazards section on the organization's MSDS. Ask students to volunteer incidents in which they or someone they know of has accidentally ingested, absorbed, or inhaled a hazardous material. Discuss the first-aid steps that were taken, and provide again the telephone number of the poison control agency.

  — Assign Assignment Sheet 3 to be completed in class so that you can walk through the class providing help and guidance where necessary. You may want to assign the students to three small groups to complete this assignment, each group analyzing, recording the results, and reporting on one of the sample MSDSs.

- Objective 10 covers the principles of body mechanics. Students enjoy demonstrating the safe standing, sitting, lying, and moving postures illustrated in this section of the Information Sheet. You may inspire them to correct posture by noting that studies have revealed that individuals with erect, alert posture were repeatedly chosen by the opposite sex as more attractive than those with poor posture.
  - Show students examples of ergonomic furniture and appliances.
  - Have students analyze their usual seated posture when using a computer and compare this posture to correct seated posture. Does their seated posture cause backache? Shoulder tension? Eye fatigue? Why? Do the same with their standing and moving postures.
  - Have students practice walking across the room with a book on their head until they can cross the room naturally without the book falling off.
  - Demonstrate the correct postures in Job Sheet 1 and have each student demonstrate each of the postures illustrated.
  - Review the safe lifting techniques outlined in Objective 10. Use Transparency Masters 3 and 4 to illustrate your explanation.
  - Demonstrate the safe lifting technique outlined in Job Sheet 1. Have each student return your demonstration. Inform students of the date on which they will be evaluated in performing Job Sheet 1.
- Objective 11 through Objective 22 deal with basic types of emergencies. Provide students with relevant examples of each of the basic types of emergencies.
- Objective 12 provides general guidelines for what to do in the event of a severe weather warning.
  - Make sure that students have a copy of and understand the organization's specific severe weather plan.
  - Tell or show students the location of the organization's emergency disaster supply kit.
  - Have students examine and test the materials in the organization's emergency disaster kit to ensure that they are usable and operable. Have them replace batteries, canned goods, and other nonfunctioning, outdated or unusable items.
  - Refer students to Student Supplement 2, Tornado Tips, in their student materials. Review the supplement, stressing the difference between the meaning of *watch* and *warning*. If earthquakes, hurricanes, or floods are prevalent in your area, provide students with and review emergency guidelines for these severe weather phenomena, also.
  - Have the class role-play the organization's severe weather drill.
  - Assign Assignment Sheet 4 to be completed in class or by an assigned date.
- When teaching Objective 13, have students practice eliciting information from an individual calling in a bomb threat. Provide students with and review the organization's building evacuation plan and standard operating procedures for handling a bomb threat.

- Combine Objective 14 and Objective 15 to describe general procedures for evacuating a building in a fire emergency for both able-bodied and disabled individuals.

  — Provide students with and review the organization's fire evacuation plan and standard operating procedures for handling oneself when fire is discovered or the fire alarm sounds.

  — Show students the location of the organization's posted fire evacuation plan and standard operating procedures for handling oneself when fire is discovered or the fire alarm sounds.

  — Explain the disabled person's fire evacuation responsibilities as outlined in Objective 15. Assign two or three students in the class the following disabilities: lower extremity paralysis and wheelchair bound, legal blindness, deafness. Assign one student the role of visitor who does not know the organization's fire escape routes or procedures. Assign four remaining students the responsibility of assisting the visitor and each of the "disabled" individuals. Have all students role-play their responsibilities and actions in responding to a fire alarm from various locations and situations in the organization.

- Objective 16 through Objective 22 deal with fire components, classes, and portable fire extinguisher markings and use. When teaching these objectives, use Transparency Masters 5 through 7 to assist you in illustrating this information.

  — Show students actual markings on fire extinguishers. Have a variety of extinguishers on display and quiz the students about the class(es) of fire for which each is suitable.

  — Stress that not all fires can or should be extinguished with a portable extinguisher. Stress the characteristics of fires appropriate for handling with a portable extinguisher outlined in Objective 20.

  — Assign Assignment Sheet 5 to be completed in class. Discuss student responses.

  — When teaching Objective 21, allow each student to come to the front of the class and "walk through" the general steps for using a fire extinguisher. Use an empty extinguisher for demonstration purposes.

  — Introduce the fire department representative and allow him or her to introduce Job Sheet 2 and to answer student questions regarding fire and extinguisher use.

  — Have students tour the organization, locating alarm boxes, extinguishers, fire exits, and escape routes, and evaluating the organization for its adherence to the fire prevention guidelines listed in Objective 22. Or, have the fire department representative lead an "inspection" tour in which these aspects are noted and explained.

- Objective 23 and Objective 24 cover electrical and basic equipment safety.

  — Review the statements concerning electrical safety in Objective 23.

  — Show students examples of and explain the following electrical equipment: plugs, fuses, outlets, electrical panels, junction boxes.

  — Explain the basic equipment safety statements in Objective 24, providing the students with the reasons for adhering to each guideline and the consequences of not following the guidelines.

- Have students complete Assignment Sheet 6 as a general review of the module. You may want to assign it to be completed by small groups in class and use discussion of it as a springboard to summarizing the lesson.

## Resources Used in Developing This Module

- *American Red Cross Community First Aid and Safety*. St. Louis, MO: Mosby Lifeline, 1993.
- Bledsoe, Brian E., Robert S. Porter, and Richard A. Cherry. *Paramedic Care: Principles & Practice: Vol. 4: Trauma Emergencies*. Upper Saddle River, NJ: Brady/Prentice Hall, 2001.
- *Cleaning Services,* "Module One: Safety, First Aid, Hazard Communications." Stillwater, OK: Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1996.
- Colonna, Guy R., Ed. *Introduction to Employee Fire and Life Safety*. Quincy, MA: National Fire Protection Association, 2001.
- Hall, Richard and Barbara Adams, Eds. *Essentials of Fire Fighting*. 4th ed. Stillwater, OK: Oklahoma State University Fire Protection Publications, 1998.
- *Power Product Equipment Technician: Theory and Principles of Engine Operation*. "Basic Workplace Safety and First-Aid Skills." Stillwater, OK: The Multistate Academic and Vocational Curriculum Consortium, Inc., 1996.

## Suggested Supplemental Resources

### Print

- Finch, William H., III. *Pocket Digest of OSHA Standards*. OSC Training Group.

  ✔ **NOTE:** Order current copy online from http://www.oshadigest.com/

- American Red Cross Community Disaster Education Materials.

  ✔ **NOTE:** Find a subject index, lists of video titles, and materials available for teachers, schools, and presenters, and order online at http://www.redcross.org/pubs/dspubs/cde.html

### Videos

- *Safety Orientation—Nursing*. 14-minute video includes safe lifting techniques, needle stick prevention, basic infection control procedures, electrical safety and other important topics. (Item no. 14001A)
- *Accident Causes and Prevention*. 10-minute video targets the cause of most accidents, unsafe acts. Explains how employees can reduce and eliminate accidents and injuries through safety awareness and attention to the job, job procedures and safety rules. (Item no. 14007A)
- *Back Safety for Health Care Providers*. 9-minute video that explains how the back works, body mechanics and how each employee can make the proper decision when lifting anything, even in awkward or unusual situations. (Item no. 14010A)
- *Lifting Patients From Beds*. 12-minute video designed for anyone required to lift patients from beds and the prone position. Explains proper body mechanics, procedures, and tips to help prevent back injuries. (Item no. 14008A)

- *Lifting Patients From Chairs*. 8-minute video designed for anyone required to lift patients from chairs or the sitting position. Explains proper body mechanics, procedures and tips to help prevent back injuries. (Item no. 14009A)
- *Fire Extinguisher Training and Use 2000*. 17-minute video that explains the various classes of fires, different types of fire extinguishers, the key word PASS, and other tips for emergency use of fire extinguishers. (Item no. 1044F)
- *Fire Protection/Electrical Safety*. 9-minute video that supplements OSHA requirements for emergency preparedness training. This program covers extinguishers, sprinklers, housekeeping, chemicals, cords, receptacles, and electrical safety. (Item no. 9014A)
- *Hazardous Energy Source (Lockout-Tagout)*. 10-minute program designed to meet new OSHA standards for locking-tagging equipment during maintenance and servicing of equipment. Designed primarily for engineering personnel, however, to meet the new OSHA rules, employees who use equipment must be properly trained in lockout-tagout procedures. (Item no. 14011A)

Available from:

MAVCC
1500 West Seventh Avenue
Stillwater, OK 74074
800-654-3988
www.mavcc.com

- *Fire Safety in the Perioperative Setting*. 20-minute video identifies areas of potential fire hazards and methods to eliminate those hazards.

  Available from:

  Ciné-Med, Inc.
  127 Main Street North
  Woodbury, CT 06798
  800-253-7657
  www.cine-med.com

**SUGGESTED WEB SITES***

- http://www.parlay.com

  Instructors may order a safety training Kopy Kit® from this Web site. A Kopy Kit is a collection of reproducible resources: one-page handouts on a variety of topics related to a theme. They are sold in three-ring binders and CD-ROMs so that licensees can easily print, copy, and download the pages onto Intranet and Internet sites. Separate licenses are sold for electronic posting rights. The basic product lines focus on the following three areas:

  — **Health Education**—Patient education and wellness promotion, stress, fitness, nutrition, chronic conditions, weight management, heart health, back care, pregnancy, self-care, life skills, substance abuse and more.

  — **Safety Training**—OSHA compliance and environmental compliance training material on safety awareness, confined spaces, slips and falls, hazcom, PPE, lifting, fire safety, electrical safety, construction safety, warehouse safety, and more.

- **Productivity Training**—Training and communication resources on teamwork, supervision, customer service, time management, workplace violence, managing work and family, sexual harassment, and more.

Click on "General Safety," and scroll down to a kit titled *The 10 Commandments of Safety*. This mini-kit offers clear, concise advice on topics such as recognizing hazards, preventing back injury, PPE, and lockout/tag-out.

- http://www.crossroads.nsc.org/index.cfm

The National Safety Council's *Crossroads* Web site is a safety, health, and environment search engine and news network that uses subject area experts to answer questions and guide users to information and resources on the Web.

- http://www.okstate.edu/ehs/links/index.htm

Oklahoma State University's online safety library contains fact sheets covering the following areas related to the content of this module:

- Back Safety
- Chemical Safety (includes MSDS and PPE fact sheets)
- Fire Extinguishers (use and identification)
- Fire Safety
- Flammable and Combustible Liquids

- www.nsc.org/library/facts.htm

This National Safety Council Fact Sheet Library contains facts sheets on severe weather preparedness, including hurricanes and coastal storms and floods, among others. Simply click on the fact sheet of interest.

- http://www.worldsafety.com

This Web site contains an easy-to-use online search for the MSDS on many products. Just input the product name and other pertinent information and then read the MSDS. A complete OSHA search is also possible at this site.

- http://www.redcross.org/pubs/dspubs/cde.html

This Web site contains a listing of all the Red Cross community disaster materials from videos, to door hang-tags, to fact sheets, booklets, and other publications.

- http://ergoweb.com/index.cfm

Ergoweb presents a guide to ergonomic products and services, articles on ergonomic practices, OSHA rules on MSDSs (musculoskeletal disorders), and defines an ergonomics injury.

- http://www.osha-slc.gov/OshDoc/toc_fact.html

  ✔ **NOTE:** OSHA web addresses are case sensitive (notice some of the capital letters in the address) and must be input exactly or you will receive an error message. The address above will take you to OSHA's fact sheet table of contents. Among others, you can find fact sheets on the following topics:

  — Back Injuries
  — Eye Protection
  — General OSHA Record Keeping Requirements
  — Protecting Yourself with PPE
  — And Workplace Fire Safety

- http://www.ou.edu/oupd/fireprim.htm

  This University of Oklahoma Web site has much to recommend it. It contains a quiz that would make an excellent pretest to introduce fire safety Titled "Everything You Ever Wanted to Know About Fire Safety (But Were Afraid to Ask)," it covers and illustrates the following information and procedures:

  — How Fires Start
  — How Fires are Classified
  — How to Prevent Fires
  — When Not to Fight a Fire
  — How to Identify the Proper Fire Extinguisher
  — How to Use a Portable Fire Extinguisher
  — How to Extinguish Small Fires
  — How to Inspect Your Fire Extinguishers
  — How to Create an Emergency Action Plan
  — How to Evacuate a Burning Building
  — What to Do if Trapped in a Burning Building
  — What to Do if Someone Catches Fire

- http://siri.uvm.edu/msds/

  The developers of this Web site state: "Our objective is to make critical safety information as immediately and universally accessible as possible. In the case of material safety data sheets, this and similar archives can benefit both safety and productivity by replacing tens of thousands of paper MSDS indexes at individual work sites with a few universal online archives. Electronic archives provide a single source where any MSDS can be instantly located; it is essential that information from all manufacturers be accessible in a single index because it is often difficult in an emergency to identify the manufacturer." This site also provides chemical toxicity data.

- http://www.the-phoenixgroup.com/

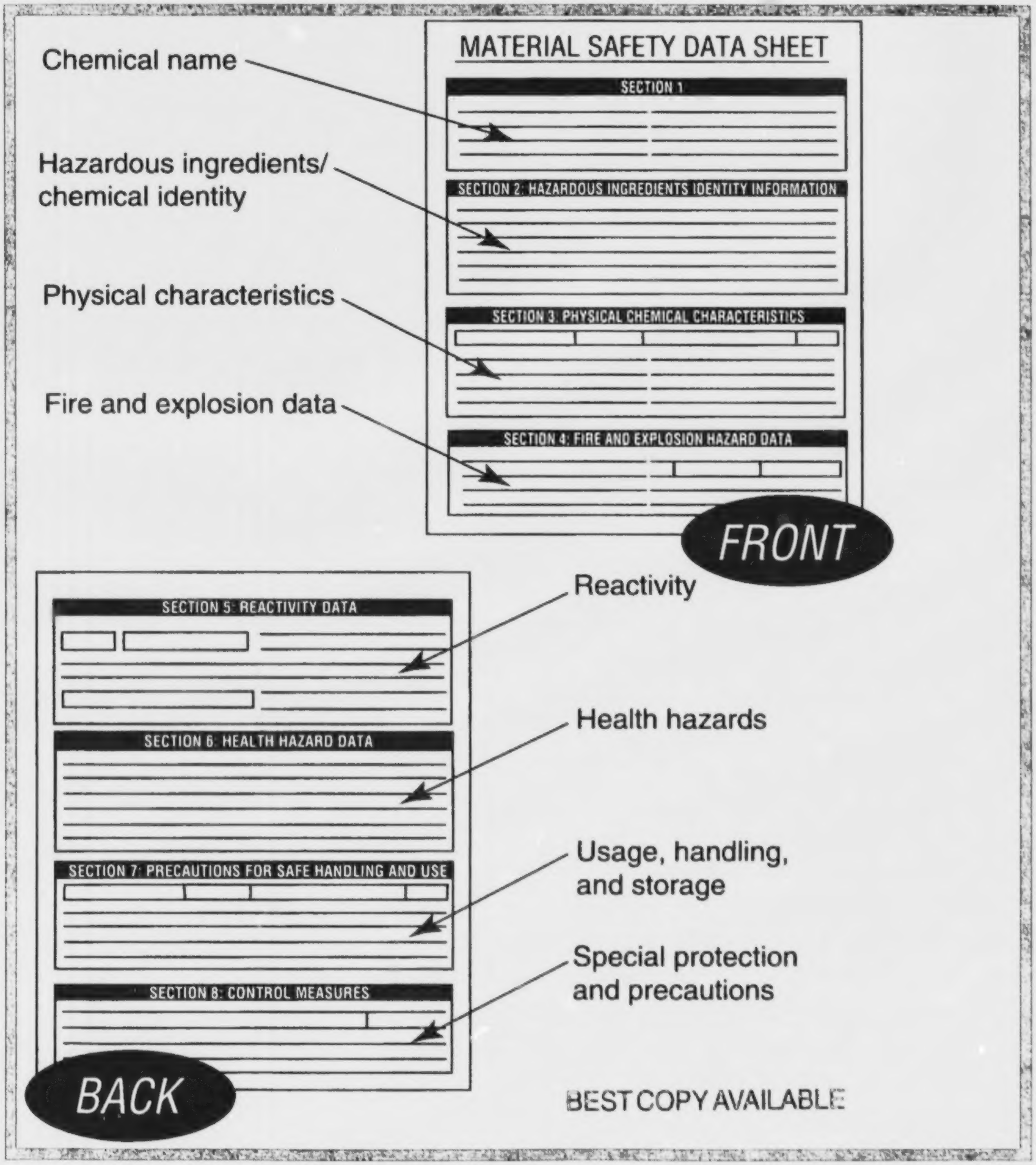
  Provides health care and hospital employee OSHA and JCAHO safety manuals.

- http://www.fema.gov/library/tornadof.htm

  On the Federal Emergency Management Agency (FEMA) Web site you will find a downloadable PDF file containing tornado information such as tornado facts, how to prepare for a tornado, danger signs, safety rules, and what to do after a tornado.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

# MSDS Example


MATERIAL SAFETY DATA SHEET
SECTION 1
SECTION 2: HAZARDOUS INGREDIENTS IDENTITY INFORMATION
SECTION 3: PHYSICAL CHEMICAL CHARACTERISTICS
SECTION 4: FIRE AND EXPLOSION HAZARD DATA
FRONT
SECTION 5: REACTIVITY DATA
SECTION 6: HEALTH HAZARD DATA
SECTION 7: PRECAUTIONS FOR SAFE HANDLING AND USE
SECTION 8: CONTROL MEASURES
BACK

Chemical name

Hazardous ingredients/ chemical identity

Physical characteristics

Fire and explosion data

Reactivity

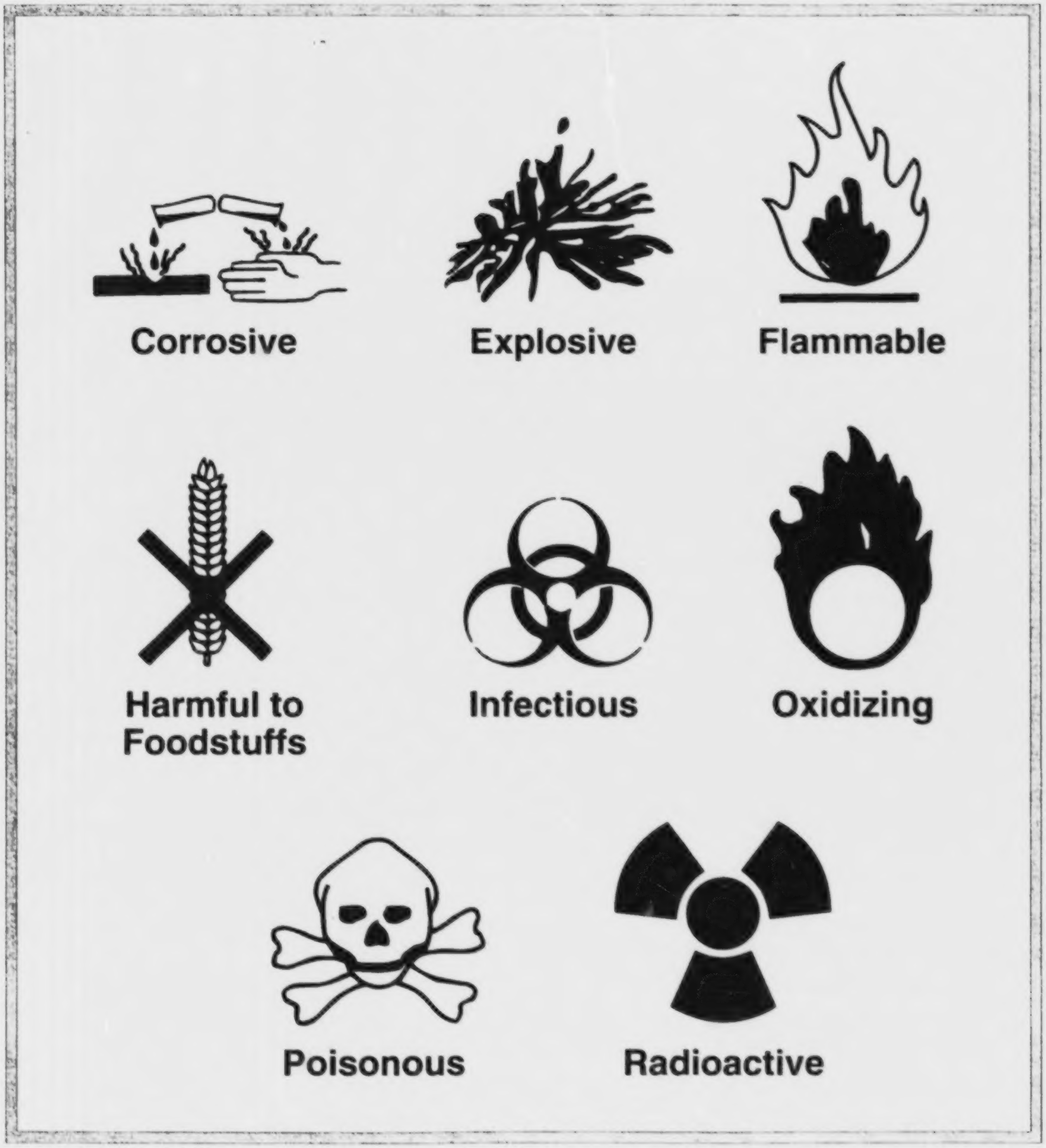
Health hazards

Usage, handling, and storage

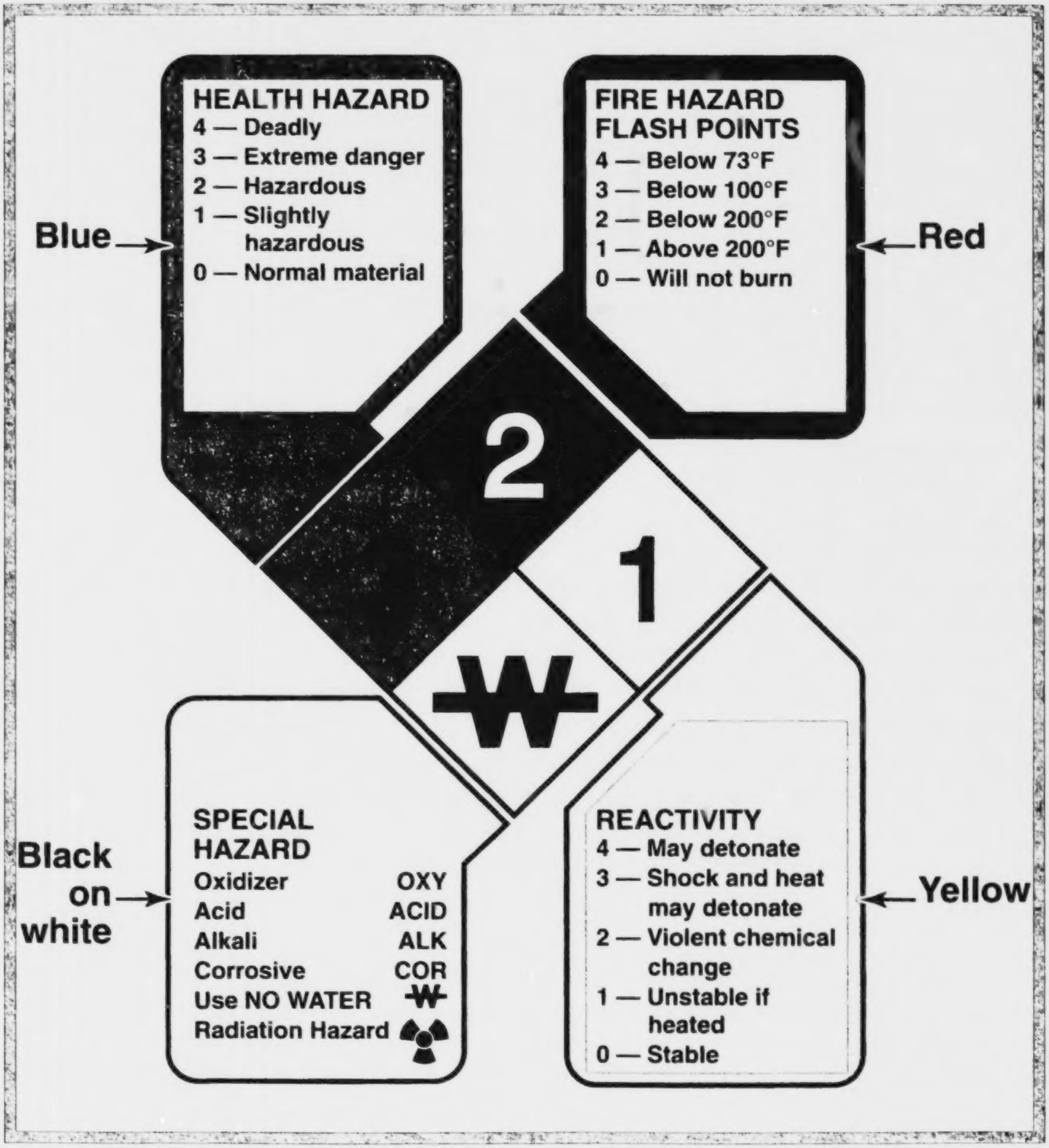
Special protection and precautions

BEST COPY AVAILABLE

# DOT Hazard Placards


Corrosive
Explosive
Flammable
Harmful to Foodstuffs
Infectious
Oxidizing
Poisonous
Radioactive

# NFPA 704 Hazard Diamond



**Blue** →

**HEALTH HAZARD**
4 — Deadly
3 — Extreme danger
2 — Hazardous
1 — Slightly hazardous
0 — Normal material

**FIRE HAZARD FLASH POINTS**
4 — Below 73°F
3 — Below 100°F
2 — Below 200°F
1 — Above 200°F
0 — Will not burn

← **Red**

**Black on white** →

**SPECIAL HAZARD**

| | |
|---|---|
| Oxidizer | OXY |
| Acid | ACID |
| Alkali | ALK |
| Corrosive | COR |
| Use NO WATER | ~~W~~ |
| Radiation Hazard | ☢ |

**REACTIVITY**
4 — May detonate
3 — Shock and heat may detonate
2 — Violent chemical change
1 — Unstable if heated
0 — Stable

← **Yellow**

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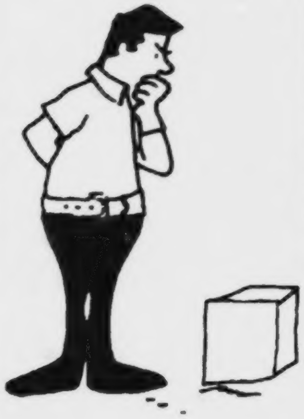
Introduction to Surgical Technology
Section B: Safety
Module 1-B: Environmental Safety

# How to Lift Safely

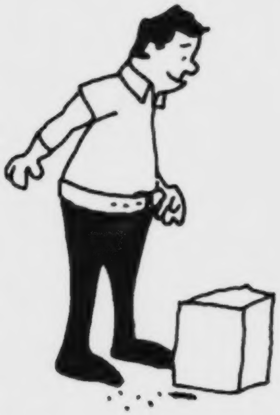
1

Approach the load and size it up as to weight, size, and shape. Consider your physical ability to handle the load.



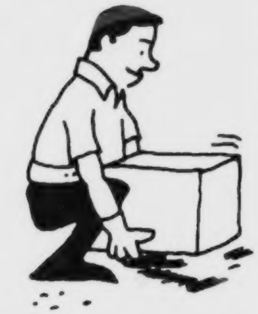
2

Place feet close to the object to be lifted and 8 to 12 inches apart for good balance.



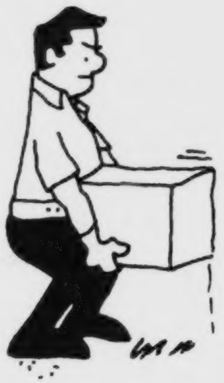
3

Bend the knees to the degree that is comfortable and get a good handhold. Then using both leg and back muscles. . .



4

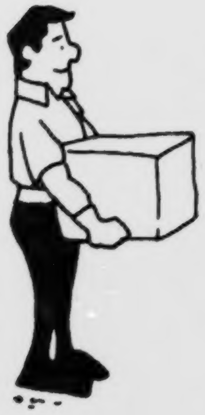
Lift the load straight up smoothly and evenly. Push with your legs, and keep the load close to your body.



# How to Lift Safely (cont.)

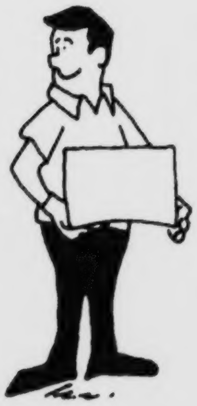
5

Lift the object into carrying position, making no turning or twisting movements until the lift is completed.



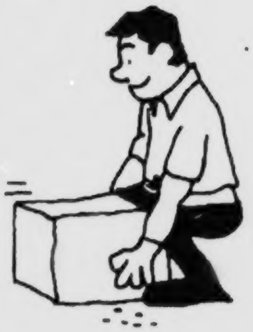
6

Turn your body with changes of foot position after looking over your path of travel, making sure it is clear.



7

Setting the load down is just as important as picking it up. Using leg and back muscles, comfortably lower load by bending your knees. When load is securely positioned, release your grip.

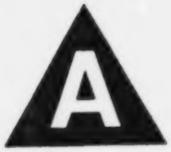


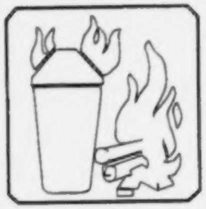
# Classes of Fuel or Fires

**Class A**

- Ordinary combustibles

(Green)

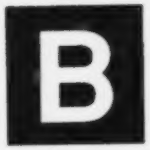


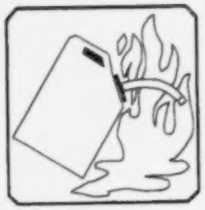


**Class B**

- Flammable liquids and gases

(Red)

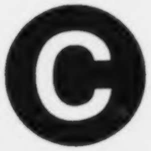


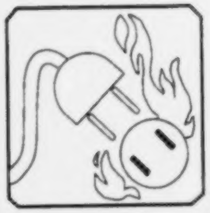


**Class C**

- Live electrical equipment

(Blue)

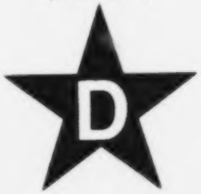


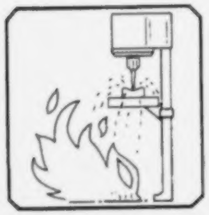


**Class D**

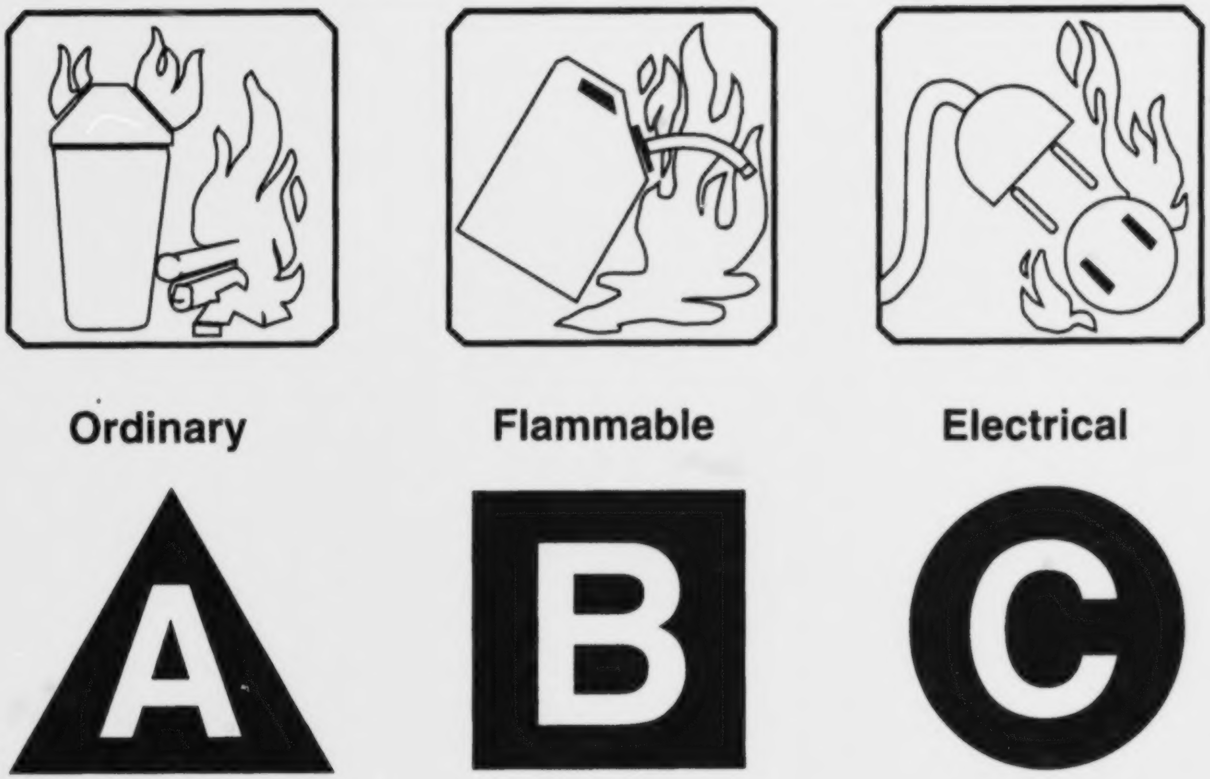
- Combustible metals

(Yellow)





# Extinguisher Markings

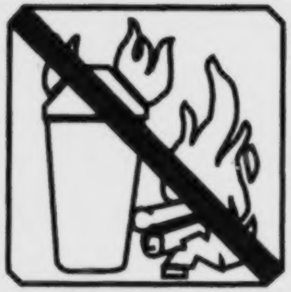
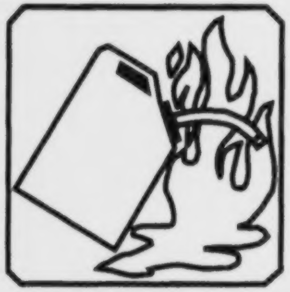
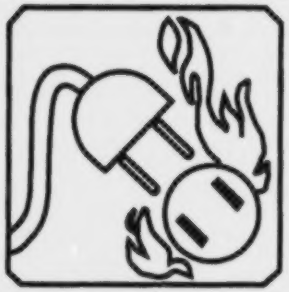
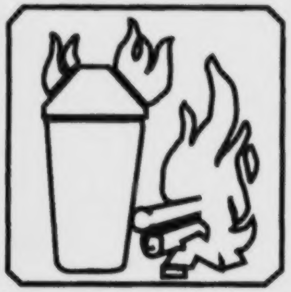
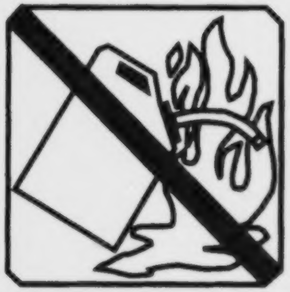
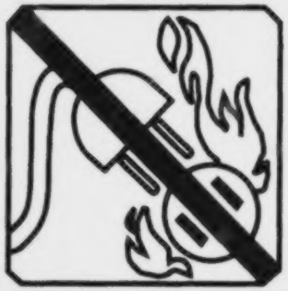
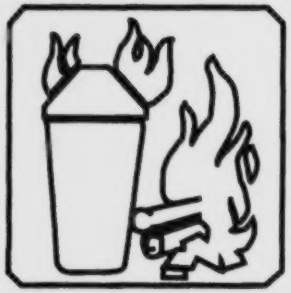
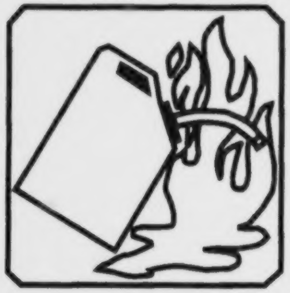
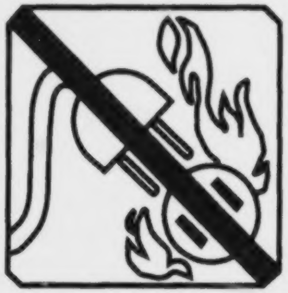


Ordinary Combustibles (Green)

Flammable Liquids (Red)

Electrical Equipment (Blue)

# Extinguisher Picture Symbols

| | | | |
|---|---|---|---|
|  |  |  | Picture symbols for extinguishers suitable for Class B and C fires, but NOT for Class A fires. |
|  |  |  | Picture symbols for extinguishers suitable for Class A fires, but NOT for Class B and C fires. |
|  |  |  | Picture symbols for extinguishers suitable for Class A and B fires, but NOT for Class C fires. |

## Written Test

Name ______________________________________________

Date ______________________ Score ____________________

**Objective 1**

Discuss four ways of developing a good safety attitude. Write your answers on the blank lines provided below.

a. ______________________________________________
______________________________________________

b. ______________________________________________
______________________________________________

c. ______________________________________________
______________________________________________

d. ______________________________________________
______________________________________________

**Objective 2**

Complete statements concerning personal safety guidelines. Write your answers on the blank lines provided in the statements below and on the next page.

a. Know the correct emergency ______________ in your area; be sure that they are posted near the ______________.

b. Comply with all ______________ and posted signs.

c. Be familiar with the location of ______________ and ______________ equipment.

d. Use the ______________ tool or equipment for the job, and use it properly.

e. Follow ______________ when performing a task.

f. Wear ________________ (safety glasses, gloves, etc.) as required.

g. Use and store potentially hazardous materials and products strictly according to the ______________ instructions and cautions.

h. Never transfer the contents of a container from the original container to another ____________________ container.

i. Never operate, adjust, modify, or repair equipment without ____________________ and proper training.

j. Tag and report ________ ____________ equipment immediately.

k. Correct or report all ____________________ conditions immediately.

l. Keep your work area ____________________ and ____________________.

**OBJECTIVE 3** List three general steps/guidelines for reporting defective equipment. Write your answers on the blank lines provided below.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

**OBJECTIVE 4** List six expectations for a safe environment at school or work. Write your answers on the blank lines provided below.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

d. ____________________________________________

e. ____________________________________________

f. ____________________________________________

**OBJECTIVE 5** State three of the purposes of a material safety data sheet (MSDS). Write your answers on the blank lines provided below.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

**Objective 6**

Match the MSDS sections to the information each contains. Write the corresponding numbers on the blanks provided.

______ a. Explains special personal protective equipment to use when working with the chemical, and provides extra health and safety information not covered in other sections

______ b. Identifies the substance and lists the date the MSDS was prepared, the name and address of the manufacturer, and usually a phone number for emergencies

______ c. Describes what happens if this chemical comes in contact with certain conditions or chemicals

______ d. Describes how to clean up an accidental spill, leak, or release, including special precautions; tells how to handle, store, and dispose of the chemical safely

______ e. Identifies flashpoint, flammability, combustibility, and the best way to put out fire involving that chemical

______ f. Names the substances in the chemical that may be dangerous, provides safe exposure limits and common names for the chemical

______ g. Describes usual or safe physical qualities such as how it looks or smells, boiling and melting temperatures, evaporation rates, how easily it dissolves, and how heavy it is compared to water

______ h. Lists ways the chemical may enter your body, symptoms of overexposure, and emergency first aid procedures

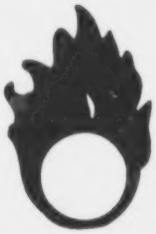
1. Chemical name
2. Fire and explosion data
3. Hazardous ingredients/chemical identity
4. Health hazards
5. Physical characteristics
6. Reactivity
7. Special protection and precautions
8. Usage, handling, and storage

**Objective 7**

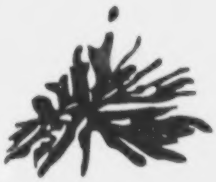
Match hazard placard and label symbols to their correct hazards. Write the corresponding numbers on the blanks provided below and on the next page.

1. Corrosive
2. Explosive
3. Flammable
4. Harmful to foodstuffs
5. Infectious
6. Oxidizing
7. Poisonous
8. Radioactive

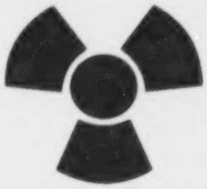
______ a.



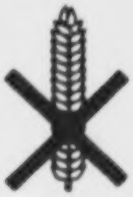
______ b.



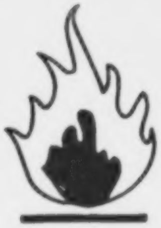
______ c.



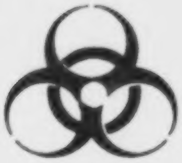
______ d.



______ e.



______ f.



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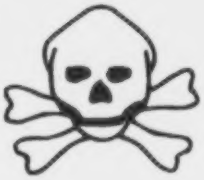
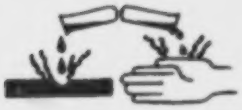
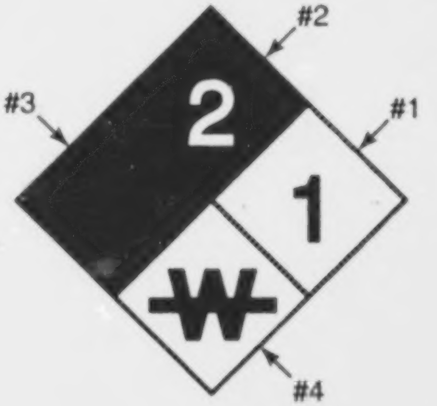


______ h.



**OBJECTIVE 8** Identify hazards using the NFPA 704 hazard triangle. Write your answers on the blank lines provided below and on the next page.



a. What color is the #1 diamond and what hazard does it represent?

______________, ______________

b. What color is the #2 diamond and what hazard does it represent?

______________, ______________

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c. What color is the #3 diamond and what hazard does it represent?

__________________, __________________

d. For the #4 diamond, what color would the letters or symbols be?

__________________

e. What does a health hazard rating of 4 mean? __________________

f. What does a fire rating of 0 mean? __________________

**OBJECTIVE 9**

Match the method by which hazardous materials can enter the body to their correct descriptions. Write the corresponding numbers on the blanks provided.

_______ a. By breathing in gases, vapors, fumes, and other forms of a material

_______ b. By mouth

_______ c. Through the skin

1. Absorption
2. Ingestion
3. Inhalation

**OBJECTIVE 10**

Complete statements concerning the principles of body mechanics. Write your answers on the blank lines provided in the statements below and on the next page.

a. Using the body correctly results in __________________ and endurance.

b. Good body mechanics prevent __________________ and __________________, especially to the back.

c. Correct standing posture

- Align __________________, __________________, __________________, knees, and ankles.
- Keep __________________ relaxed and __________________ slightly bent.
- Place feet slightly apart to improve balance.
- Rest one foot on a footstool or rail to ease strain on your back when standing for an extended period.
- Stand as close to the work area as possible to prevent reaching.

d. Correct sitting posture

- Align __________________ over shoulders and shoulders over __________________.

- Place a ________________ roll or rolled up towel between your lower back and the back of nonadjustable chairs.
- Adjust chair height and seat back firmness and angle as necessary.
- Rest your buttocks against the ________________ and keep your feet on the floor or footstool.
- Place your computer screen at eye height and at a comfortable distance from your eyes.
- Adjust the height of the work area as necessary.

e. Correct lying (or sleeping) posture

- Rest on your ________________ with your knees slightly bent toward your chest.
- Rest on your ________________ with a pillow placed under your knees.
- Sleep with only one pillow under your head.
- Choose a ________________ mattress.

f. Moving correctly

- Walk with your head ________________ and your shoulders ________________.
- Cushion and support your wrist and arm when using a computer keyboard and mouse.
- Occasionally move and stretch your joints freely through entire range of motion.
- Use carts, wheelchairs, bed sheets, or other devices to lift and carry objects whenever possible.
- ________________, roll, or slide the object when a lifting or carrying device is not available.
- Ask for help when you must carry a large object, and then ensure that you and your helper coordinate movements and carry the object on the same side of the body and at the same level.
- Use ________________ rather than chairs or boxes to reach high objects.
- Avoid over-reaching or stretching to reach high objects.

**OBJECTIVE 11** List four basic types of emergencies. Write your answers on the blank lines provided below.

a.

b.

c.

d.

**OBJECTIVE 12** Discuss severe weather safety guidelines. Write your answers on the blank lines provided below.

*Before severe weather occurs*

a.

b.

c.

d.

e.

*During severe weather*

a.

b.

c.

d.

**OBJECTIVE 13**

Arrange in order the steps to follow on receiving a bomb threat. Place a "1" next to the first step, a "2" next to the second step, and so on.

_______ a. Follow your building evacuation plan.

_______ b. Alert your instructor, supervisor, or building administrator of the bomb threat.

_______ c. When you answer the call, obtain as much information as you can about the caller, recording the call if possible.

_______ d. Do not return to the building until the "all clear" signal is given.

**OBJECTIVE 14**

Complete guidelines for general evacuation procedures in a fire emergency. Write your answers on the blank lines provided in the statements below and on the next page.

*Upon discovery of fire or smoke or upon activation of a smoke detector—*

a. ________________ the doors around the fire to ________________ it, if doing so does not compromise your safety.

b. Do not attempt to ________________ or ________________ the fire unless you have been trained to do so.

c. Pull the nearest ________________.

d. ________________ the building immediately according to evacuation plans.

e. Proceed to your ______________________ and answer to roll call.

f. ________________ or local fire department phone number if in a rural area to notify the fire department of the fire and its exact location.

g. Notify the building administrator of the ________________ of the fire.

*At the sound of a fire alarm—*

h. ________________ any machinery or processes in your area of responsibility.

i. Carefully feel several areas of any closed doors; if the door is ________________; do not open it.

j. Check the exit path for ________________ or fire.

k. If the exit path is clear of ________________ and ________________, remain calm and immediately walk—do not run—to the nearest exit, and leave the building.

l. If you can smell but not see smoke, place a wet towel over your ___________________ and hold a wet cloth to your ___________________ and ___________________ when exiting if possible.

m. To limit fire or smoke damage, ___________________ all doors and windows when leaving the room, if doing so does not compromise your own safety.

n. ___________________ all hallway doors as you leave, if doing so does not compromise your own safety.

o. Assist ___________________ persons to a secure area—such as a stairwell—and inform responding fire department personnel of their location.

p. Use the ___________________, not the ___________________.

q. Leave the building in an orderly manner, and proceed to the ___________________________.

**OBJECTIVE 15** Describe the disabled person's fire evacuation responsibilities. Write your answer on the blanks provided.

*Pre-emergency responsibilities*

_____________________________________________

_____________________________________________

_____________________________________________

_____________________________________________

_____________________________________________

_____________________________________________

*Evacuation responsibilities*

_____________________________________________

_____________________________________________

_____________________________________________

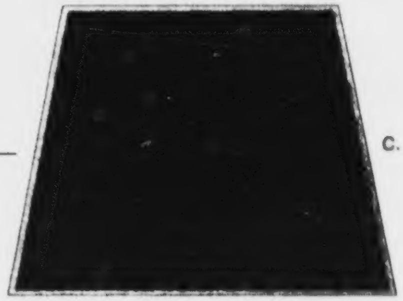
_____________________________________________

_____________________________________________

_____________________________________________

**OBJECTIVE 16** Identify the components of fire by labeling the sides of a fire tetrahedron.

b. ____________________



a. ____________________

c. ____________________

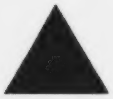
d. ____________________

**OBJECTIVE 17** Match the fire classifications to their fuel sources. Write the corresponding numbers on the blanks provided.

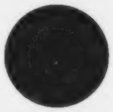
| | | | |
|---|---|---|---|
| ______ | a. | Live electrical equipment, wiring, appliances, motors | 1. Class A |
| ______ | b. | Wood, paper, rubber, plastic, trash, cotton bedding | 2. Class B |
| ______ | c. | Combustible metals | 3. Class C |
| ______ | d. | Gasoline, oil, grease, gases (oxygen), paints, anesthetic agents | 4. Class D |

**OBJECTIVE 18** Match fire extinguisher symbol shapes to fire classification letters. Write the corresponding numbers on the blanks provided.

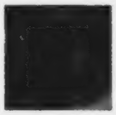
1.



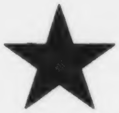
2.



3.



4.



______ a. Class A

______ b. Class B

______ c. Class C

______ d. Class D

**OBJECTIVE 19** Match fire extinguisher pictographs to the extinguisher's intended purposes Write the corresponding numbers on the blanks provided below.

_______ a. Class A

_______ b. Class B

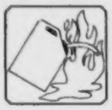
_______ c. Class C

_______ d. Class A fires but not Class B or C

_______ e. Class A and B fires but not Class C

_______ f. Class B and C fires but not Class A

1.



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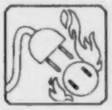

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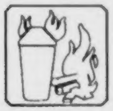
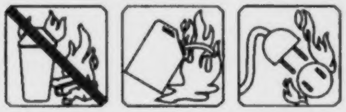
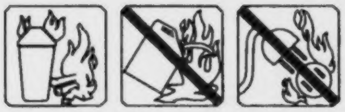


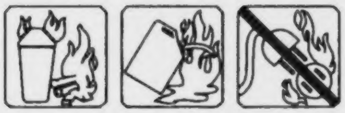
4.



5.



6.



**OBJECTIVE 20** List four characteristics of fires appropriate for handling with a portable fire extinguisher. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 21**

Arrange in order the general steps in using a fire extinguisher. Place a "1" next to the first step, a "2" next to the second step, and so on. Write your answers on the blanks provided.

_______ a. Pull the pin to break the inspection band.

_______ b. Sweep the nozzle from side to side until the fire appears to be out, repeating the process if fire breaks out again.

_______ c. Aim the extinguisher nozzle or horn at the base of the fire.

_______ d. Squeeze the handle to release the extinguishing agent.

_______ e. Identify the fire class and then check the extinguisher label to make sure that the extinguisher is coded to put out that type of fire.

**OBJECTIVE 22**

List eight fire prevention guidelines. Write your answers on the blank lines provided below.

a. ________________________________________
________________________________________

b. ________________________________________
________________________________________

c. ________________________________________
________________________________________

d. ________________________________________
________________________________________

e. ________________________________________
________________________________________

f. ________________________________________
________________________________________

g. ________________________________________
________________________________________

h. ________________________________________
________________________________________

**OBJECTIVE 23**

Complete statements concerning electrical safety. Write your answers on the blank lines provided in the statements below and on the next page.

a. Do not use any electrical appliance or equipment while you are touching ________________ or ________________.

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b. __________________ electrical equipment before cleaning, inspecting, repairing, or removing anything from it.

c. Keep electrical equipment and work areas __________________ to prevent electrical fires.

d. Know that electrical __________________ can ignite nearby flammable materials.

e. Keep access to electrical panels and junction boxes __________________.

f. Keep flammable materials away from electrical heat sources, including __________________.

g. Know the location of fuses and ________________________.

h. Make sure all electrical equipment is properly __________________.

i. Plug power tools into grounded outlets equipped with ________________________.

j. Never use __________________ on electrical fires.

**OBJECTIVE 24** Select true statements concerning basic equipment safety. Write an "X" on the blanks next to the true statements.

_______ a. Rings and other jewelry may be worn when operating power equipment.

_______ b. Secure long hair and loose clothing when working with or near power equipment.

_______ c. Wear personal protective equipment as required.

_______ d. Use equipment and tools only for their intended purposes.

_______ e. Never use any equipment unless you are trained to do so.

_______ f. Inspect equipment once a week; replace it or have it repaired by a qualified individual if parts are worn or damaged.

_______ g. Connect the power to equipment before performing any maintenance tasks.

_______ h. Make sure the power switches are turned to ON before plugging or unplugging equipment.

_______ i. Never disconnect the power by pulling on the cord; instead, remove the plug from the outlet.

_______ j. Make sure your hands are wet before disconnecting equipment from its power source.

_______ k. Keep electrical cords out of traffic areas.

_______ l. Do not leave or store equipment in aisles or traffic lanes that could present a tripping hazard.

***Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1**

Answers should include any four of the following. Answers may appear in any order.

a. Focus on the task at hand.

b. Stay alert; accidents happen easily when you are tired or bored.

c. Take time to do the job right; do not take shortcuts.

d. Determine your priorities—what needs to be done first, second, and so on—so that you do not run out of time to complete high-priority tasks.

e. Use your head; think before you act.

f. Do not fool around or let emotions such as anger or frustration get in the way of your doing a job safely.

g. Take responsibility for your actions and for those of your team.

h. Avoid unnecessary risks.

**OBJECTIVE 2**

a. telephone numbers; telephone
b. safety rules
c. fire-fighting; first-aid
d. right
e. instructions
f. personal protective equipment
g. label
h. unauthorized
i. permission
j. defective
k. unsafe
l. clean; neat

**OBJECTIVE 3**

Answers should include any three of the following. Answers may appear in any order.

a. Visually inspect all electrical equipment before and after each use for any signs of defects or malfunctions.

b. Immediately notify your instructor if you discover a defective piece of equipment.

c. Lockout the equipment per the organization's SOPs.

d. Tag-out the equipment per the organization's SOPs.

e. Remove the piece of equipment from the operations area if possible.

f. Do not use the lockout lock and key for any other purpose.

**Objective 4**

Answers should include any six of the following. Answers may appear in any order.

a. Adequate lighting to prevent eyestrain and to allow performance of required duties
b. Clean air
c. Comfortable, ergonomic seating and equipment that encourages good body mechanics
d. Working emergency alarm and lighting systems
e. Clearly marked, unlocked, and accessible emergency exits
f. Clear, barrier-free walkways accessible to all
g. Posted safety rules
h. Posted evacuation routes and rules
i. Mandatory safety training available to all
j. Available personal protective equipment
k. Designated smoking and nonsmoking areas
l. Clearly identified hazardous materials
m. Available material safety data sheets on all hazardous materials in the organization
n. Lighted, open parking and entrance areas
o. Up-to-date, operable fire extinguishers

**Objective 5**

Answers should include any three of the following. Answers may appear in any order.

a. To inform the user of the material's physical properties or fast-acting health effects that make it dangerous to handle
b. To tell the user the level of protective gear needed
c. To tell the user the first-aid treatment necessary if exposed to the product or its hazards
d. To tell management and the user the preplanning needed for safely handling spills, fires, and day-to-day operations
e. To tell the user how to respond to accidents

**Objective 6**

a. 7
b. 1
c. 6
d. 8
e. 2
f. 3
g. 5
h. 4

**Objective 7**

a. 6
b. 2
c. 8
d. 4
e. 3
f. 5
g. 7
h. 1

**Objective 8**

a. yellow; reactivity
b. red; fire
c. blue; health
d. black
e. deadly
f. will not burn

**Objective 9**

a. 3
b. 2
c. 1

**Objective 10**

a. coordination
b. fatigue; injury
c.
  - ears; shoulders; hips
  - shoulders; knees
d.
  - ears; hips
  - lumbar
  - chair back
e.
  - side
  - back
  - firm
f.
  - up; back
  - Pivot
  - ladders

**Objective 11**

Answers should include any four of the following. Answers may appear in any order.

a. Fires
b. Mechanical failures
c. Bomb and bomb threats
d. Severe weather
e. Natural disasters
f. Accidents
g. Health problems

**Objective 12**

Discussion should include the following in the student's own words.

*Before severe weather occurs:*

a. Know your organization's severe weather plan and your role in it.

b. Make sure that you know where to go in the event of severe weather.

c. Take part in the organization's periodic severe weather drills.

d. Know the location of the organization's emergency disaster supply kit, which should include a first-aid kit, battery-powered radio and flashlight with extra batteries, a canned food and can opener, and bottled water.

e. Learn where to get weather information, and the meaning of "watch" and "warning."

*During severe weather:*

f. When alarms, sirens, or warnings are issued by the local civil defense or national weather center, follow your severe weather plan.

g. Move quickly and quietly to your planned shelter:

  - In nursing homes, hospitals, schools: seek shelter on the lowest level and in the interior of the building, away from glass and outside openings.
  - In high-rise buildings: you may not have time to go to the lowest floor, so seek shelter in a hallway or small room in the interior of the building away from windows; do not use or seek shelter in an elevator.

h. Do not seek shelter in dining halls, gyms, or other large rooms with wide-span roofs.

i. Make yourself as small as possible by crouching down.

j. Put your head down and cover it and your face with your arms.

k. Answer to roll call if at school.

l. Remain in designated area until the signal is given to return.

**Objective 13**

a. 3
b. 2
c. 1
d. 4

**OBJECTIVE 14**

*Upon discovery of fire or smoke or upon activation of a smoke detector—*

a. Close; contain
b. extinguish; fight
c. fire alarm
d. Exit
e. designated meeting area
f. Dial 911
g. location

*At the sound of a fire alarm—*

h. Shut down
i. hot
j. smoke
k. smoke; fire
l. head; nose; mouth
m. close
n. Close
o. disabled
p. stairs; elevator
q. designated meeting area

**OBJECTIVE 15**

Discussion should include the following in the student's own words.

*Pre-emergency responsibilities—*

a. Be familiar with your workplace buildings and their exits.

b. Know and share the safest method to use to assist you.

c. Know how many people you need to provide you with assistance.

d. Whenever possible, try to have a designated person or persons assist you during the evacuation.

e. Be prepared to explain how and where you need to be supported.

f. Practice instructions beforehand.

*Evacuation responsibilities—*

g. Check the hallway for smoke and fire.

h. If the hallway is clear of smoke and fire—

  - Go to the nearest stairwell.
  - Remain as close to the stairs as possible, without hindering the exit of others.
  - Do not use the elevators.
  - Have a previously designated person contact fire personnel for assistance.

**OBJECTIVE 15 (CONT.)**

i. If there is smoke or flames in the hallway—

- Stay in the room with the doors closed.
- Place wet clothing or towels at the bottom of the door if possible.
- Call 911 and give the operator your exact location.
- Place a wet cloth over your mouth and nose, if possible, and wait until someone arrives to assist you.

**OBJECTIVE 16**

Answers may appear in any order.

a. Oxygen
b. Fuel
c. Heat
d. Chemical reaction

**OBJECTIVE 17**

a. 3
b. 1
c. 4
d. 2

**OBJECTIVE 18**

a. 1
b. 3
c. 2
d. 4

**OBJECTIVE 19**

a. 3
b. 1
c. 2
d. 5
e. 6
f. 4

**OBJECTIVE 20**

Answers should include any four of the following. Answers may appear in any order.

a. The fire is contained, as in a trash can, and is not spreading beyond the spot where it started.

b. The flames are not higher than the employee's head.

c. The heat from the fire does not prevent the employee from getting close enough to discharge the extinguisher within its effective range.

d. The size of the fire allows the employee to stand upright without experiencing radiated heat while discharging the extinguisher.

e. The fire cannot block the employee's only means of escape.

f. The employee can fight the fire with his or her back to an escape exit.

g. The fire is not producing a lot of smoke.

h. The fire is not near other fuels or hazardous materials that would cause it to grow suddenly or create an explosion.

**OBJECTIVE 21**

a. 2
b. 5
c. 3
d. 4
e. 1

**OBJECTIVE 22**

Answers should include any eight of the following. Answers may appear in any order.

a. Keep equipment clean and in good operating condition.

b. Never overload electrical outlets.

c. Store flammables/combustibles in appropriate containers away from heat sources.

d. Keep heat sources away from flammables/combustibles.

e. Keep work and trash areas clean and free of debris.

f. Dispose of flammables according to established safety guidelines.

g. Never leave open flames unattended.

h. Use caution when using spark-producing equipment.

i. Report suspicious persons (possible arsonists) to security or supervisory personnel.

j. Keep fire exits unlocked.

k. Keep escape routes clear and well marked.

l. Know where fire alarm boxes are located.

m. Know where fire extinguishers are located and how to use them.

n. Always be on the lookout for fires or conditions that could cause fires or hinder escape and report them immediately.

o. Properly dispose of cigarettes and matches.

p. Smoke only on designated breaks and in designated areas.

**OBJECTIVE 23**

a. metal; water
b. Unplug
c. clean
d. sparks
e. clear
f. lights
g. circuit breakers
h. grounded
i. ground fault circuit interrupters (GFCI)
j. water

**OBJECTIVE 24**

b, c, d, e, i, k, l

## Answers to Assignment Sheets

**Assignment Sheet 1**

Completed to the satisfaction of the instructor

**Assignment Sheet 2**

1. No. Both you and June are at risk of infection from a bloodborne pathogen.
2. No. You must attend to June's injuries and interview her for information needed for the accident report.
3. Immediately notify your supervisor and follow his or her instructions. File an accident report.

**Assignment Sheet 3**

**MSDS 1—Hydrogen Peroxide (45%-59%)**

1. It is an oxidizer and corrosive
2. Sterilization
3. Johnson & Johnson
4. It is corrosive to the skin and eyes, nose, throat, and lungs. It may cause irreversible tissue damage to the eyes, including blindness.
5. Wash with large amounts of water. If irritation occurs, see a physician.
6. Hydrogen peroxide should be stored only in vented containers in cool areas out of direct sunlight and away from combustibles.
7. No. It is not combustible or explosive.
8. No. The International Agency for Research on Cancer concluded that hydrogen peroxide could not be classified as to its carcinogenicity to humans (Group III carcinogen).
9. 5.1 (oxidizer)
10. Aseptic packaging, drinking water treatment, metal treatment, semiconductor wafer etching and cleaning, pharmaceutical and/or cosmetic applications

**MSDS 2—CIDEX® OPA Solution**

1. High-level disinfectant

2. Advanced Sterilization Products
3. Because it contains less than 1% active ingredients (it is 99.45% inactive) and is not a carcinogen
4. Minimal hazard; negligible
5. Double gloves, latex covered by nitrile rubber
6. Clear, light blue
7. Preexisting asthma, bronchitis, dermatitis, and other skin disorders

**MSDS 3—Institutional Formula Drano**

1. Sodium hydroxide and water
2. Corrosive. Can cause permanent damage to the skin and eyes, including blindness, if contacted directly; may cause irritation and corrosive effects to the nose, throat, and respiratory tract if inhaled; may cause burns to the mouth, throat, and stomach if ingested
3. Do not induce vomiting. Immediately drink plenty of water. Get medical attention immediately.
4. Eyes, chemical splash goggles; hands, chemical resistant gloves, including rubber and neoprene gloves; respiratory, adequate ventilation
5. Ammonia

**Assignment Sheet 4**

**Scenario 1**

1. Know that a tornado watch means that conditions favor tornado development but that you are not in immediate danger.
2. Make plans for taking shelter.
    - Locate your organization's severe weather plan
    - Locate your organization's emergency disaster supply kit
    - Think about where you will go to take shelter
3. Continue to watch for threatening conditions.

**Scenario 2**

1. Know that a tornado warning means that a tornado has been spotted or reported on the ground in your area or indicated by Doppler radar, and that you must take shelter immediately.
2. Follow your organization's severe weather plan.

3. Since you are on the fifth floor of the building, you may not have time to go to the lowest floor, so take shelter in a hallway or small room in the interior of the building away from windows.
4. Do not seek shelter in the elevators.
5. Once in the sheltering area, crouch down and cover your face with your arms.
6. Remain in the sheltered area until the signal is given to return.

**Assignment Sheet 5**

**Scenario 1**

1. Immediately shut the door to the storage room.
2. Inform Almed in calm, simple terms that there is a fire in the storage room and that you and he must evacuate the building immediately; take his hand or tell him to stay close to you.
3. Do not attempt to fight the fire with a portable fire extinguisher (it is not contained and is spreading rapidly in a room full of combustibles).
4. Grab several lab coats and exit the lab, closing the door behind you.
5. Pull the nearest fire alarm.
6. Exit the building immediately.
   - Follow the building's evacuation route.
   - Do not use the elevators.
   - Close hallway doors as you leave if this does not compromise your safety.
7. Donning the lab coats to provide some protection against the cold and rain outside, lead Almed out of the building, proceed to your designated meeting place, and answer to roll call.
8. Using a cell phone or a nearby public phone, dial 911 to notify the fire department of the fire and its exact location.
9. Notify the building administrator or your supervisor of the location of the fire.

**Scenario 2**

1. Press the button that holds the elevator doors open.
2. Exit the elevator immediately.
3. Tell the visitors that you will lead them out of the building via the hospital's evacuation route.
4. Reassure Jean, your nonambulatory patient, of the hospital's patient evacuation plan, and wheel her to the stairwell or another secure area, cautioning her to stay there so that fire and hospital personnel will know her exact location for rescue.

5. Check the evacuation route for smoke or fire; do not enter smoke.

6. Close all doors along the evacuation corridors, unless so doing will compromise your safety.

7. Assisting the visitors, leave the building in an orderly manner, proceed to the designated meeting area, and answer to roll call.

### Assignment Sheet 6

#### Personal Protective Equipment and Attire

1. Answer will vary and must be evaluated to the satisfaction of the instructor.

2. Answer will vary and must be evaluated to the satisfaction of the instructor.

#### Safety Procedures

1. Answer will vary and must be evaluated to the satisfaction of the instructor.

2. In both facilities, tag the equipment and report it as defective per the guidelines in Objective 3 and the organization's standard policies and procedures.

3. In both facilities, consult the organization's MSDS, as explained in Objectives 5, 6, and 26, and follow the recommended safety steps and the organization's standard policies and procedures.

4. Answer is appropriate per guidelines in Objective 11 and the organization's standard bomb threat policies and procedures.

#### Severe Weather

1. Take shelter per guidelines in Objective 10 for school and high-rise structures and the organization's standard severe weather policies and procedures.

2. In both facilities, keep in touch with the latest weather reports and prepare to take immediate shelter should the watch change to a warning.

#### Fire Safety

1. If you have been trained to do so, extinguish the fire with a portable extinguisher per the guidelines and steps in Objectives 19 and 30.

2. The fire is too large to fight. Do not attempt to extinguish the fire with a portable extinguisher. Instead, immediately pull the fire alarm and evacuate the building per guidelines for both school and high-rise structures in Objective 12.

## Module Review

Name ______________________________________________

Date ______________________ Score ______________________

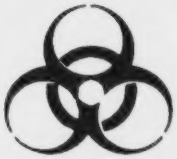
**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 4

1. Which of the following would NOT be an expectation for a safe school or work environment?
   a. designated smoking area
   b. covered parking
   c. mandatory safety training
   d. MSDSs on all hazardous materials in the organization

Objective 7

2. What type of hazard does the placard symbol below indicate?
   a. corrosive
   b. infectious
   c. explosive
   d. radioactive



Objective 10

3. Which of the following is NOT a guideline for good sitting posture?
   a. Keep your feet on the floor or a footstool.
   b. Align ears, shoulders, and hips.
   c. Rest your buttocks on the edge of the seat.
   d. Place a lumbar roll or rolled up towel between your lower back and the back of nonadjustable chairs.

Objective 5

4. The purposes of an MSDS are to inform the substance user of all of the following except the ______.
   a. substance's physical properties
   b. degree of injury inflicted
   c. first-aid treatment necessary
   d. accident response

Objective 13

5. Which of the following is NOT a step to follow on receiving a bomb threat?

a. Obtain as much information as you can about the caller.

b. Record the call if possible.

c. Transfer the call to the local police department.

d. Alert your instructor, supervisor, or building administrator.

Objective 2

6. Which of the following unsafe conditions does NOT need to be reported immediately?

a. defective equipment

b. spills

c. boxes piled in a hallway

d. a co-worker's unclean, sloppy work area

Objective 14

7. What is the first thing you should do upon discovering a spreading fire?

a. Pull the nearest fire alarm.

b. Dial 911.

c. Locate the proper portable extinguisher and extinguish the fire.

d. Close the doors around the fire to contain it.

Objective 10

8. What should you do when you must lift a heavy object, and a lifting or carrying device is unavailable?

a. Lift and carry the object in series of short distances.

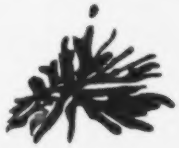
b. Pivot, roll, or slide the object.

c. Push the object with your feet and leg muscles.

d. Alternate carrying and pushing the object.

Objective 7

9. What type of hazard does the placard symbol below indicate?



a. corrosive

b. infectious

c. explosive

d. radioactive

Objective 15

10. Which of the following is NOT one of a disabled person's pre-fire emergency evacuation responsibilities?

    a. being familiar with the workplace buildings and exits

    b. knowing and sharing the safest method to use to assist you

    c. practicing self-evacuation using the building's elevator system

    d. knowing who is designated to assist you during the evacuation

Objective 3

11. What procedure is defined as: *"a procedure ensuring that all hazardous energy sources to a defective tool or machine are locked in the OFF position before maintenance is performed"*?

    a. lockout

    b. tag-out

    c. code-out

    d. mark out

Objective 23

12. In accordance with electrical safety guidelines, you should not use any electrical appliance or equipment while you are touching metal or ______.

    a. plastic

    b. wood

    c. water

    d. rubber

Objective 12

13. What item(s) below would NOT generally be found in an emergency disaster supply kit?

    a. drinking water

    b. battery powered radio and flashlight

    c. extra batteries

    d. cell phone

Objective 6

14. Which section of an MSDS describes what happens if the chemical comes in contact with certain conditions or other chemicals?

    a. hazardous ingredients

    b. reactivity

    c. usage, handling, and storage

    d. special protection and precautions

Objective 1

15. In developing a good safety attitude, you must learn to ______ the task at hand.

    a. complete

    b. focus on

    c. practice

    d. vocalize the steps of

Objective 22

16. In accordance with fire prevention guidelines, fire exits/doors should be kept ______.

    a. locked

    b. unlocked

    c. open

    d. closed

Objective 8

17. What color is the Reactivity quadrant of the NFPA 704 diamond?

    a. yellow

    b. white

    c. blue

    d. red

Objective 24

18. Which of the following is a violation of basic equipment safety procedures?

    a. disconnecting the power from equipment before performing maintenance tasks

    b. turning power switches to OFF before plugging or unplugging equipment

    c. removing the plug from an outlet by pulling on the cord

    d. making sure that your hands are dry before disconnecting power equipment

Objective 16

19. The four parts of the fire tetrahedron (those components that must be in place for fire to occur) are fuel, heat, chemical chain reaction, and ______.

    a. combustion

    b. hydrogen

    c. ignition

    d. oxygen

Objective 20

20. What fire below should/could you attempt to fight with a portable fire extinguisher?
    a. fire between you and the only exit
    b. smoky fire
    c. fire near other combustibles
    d. confined fire with chest-level flames

Objective 23

21. What type of outlet should you use when using power tools?
    a. three-hole grounded outlet with ground fault circuit interrupter
    b. two-hole outlet
    c. three-hole grounded outlet
    d. heavy-duty 220 outlet

Objective 10

22. What muscles should be used primarily for lifting?
    a. leg
    b. back
    c. arm
    d. shoulder

Objective 1

23. Who is responsible for an individual's safety?
    a. the individual
    b. the administration
    c. the instructor
    d. everyone involved

Objective 6

24. What is meant by the term *combustible*?
    a. capable of igniting easily and burning or spreading rapidly
    b. capable of bursting into flames at temperatures above 100°F
    c. capable of igniting at very low temperatures
    d. capable of exploding on contact with certain conditions or chemicals

Objective 8

25. What color is the Special Hazard quadrant of the NFPA 704 diamond?

    a. white

    b. yellow

    c. blue

    d. red

Objective 12

26. Where should you take shelter from severe weather if you are in a high rise building?

    a. basement or lowest floor

    b. small interior room or elevator

    c. interior hallway

    d. dining hall, gym, or room with wide span roof

Objective 18

27. What shape is the flammable liquids symbol on a portable fire extinguisher?

    a. triangle

    b. circle

    c. star

    d. square

Objective 20

28. In which of the situations below should you NOT attempt to fight the fire with a portable fire extinguisher?

    a. You can get close enough to discharge the extinguisher within its effective range.

    b. The size of the fire allows you to stand upright without feeling radiated heat while discharging the extinguisher.

    c. The fire is blocking your only means of escape.

    d. You can fight the fire with your back to an escape exit.

Objective 23

29. Where are GFCI most commonly used?

    a. bedroom

    b. kitchen and bathroom

    c. living room

    d. family room

Objective 17

30. Into what fuel class do gases, such as oxygen, belong?

    a. ordinary combustibles

    b. flammable liquids

    c. electrical equipment

    d. combustible metals

Objective 21

31. The first letters in the general steps for using a portable fire extinguisher spell "I PASS." What do these letters stand for?

    a. Interpret, Push, Aim, Spray, Spread

    b. Inform, Pry, Aim, Stroke, Shower

    c. Identify, Pull, Aim, Squeeze, Sweep

    d. Implement, Press, Aim, Start, Swing

Objective 9

32. The process of a hazardous material entering the body via the mouth is called ______.

    a. *digestion*

    b. *absorption*

    c. *inhalation*

    d. *ingestion*

Objective 6

33. What term is defined as: *"the lowest temperature at which a substance when heated will ignite"*?

    a. flammability

    b. combustibility

    c. ignition point

    d. flashpoint

Objective 15

34. Assume that you are disabled or that your exit path is blocked by smoke. What action below should you NOT take?

    a. Crawl low under the smoke to the exit, staying close to a wall.

    b. Stay in a room with the doors closed.

    c. Place wet clothing or towels at the bottom of the door if possible.

    d. Call 911 and give the operator your exact location.

Objective 3

35. Which of the statements below illustrates unsafe behavior?

   a. A surg-tech uses the hospital's lockout lock and key on her employee locker.

   b. A surg-tech uses the tag-out rather than the lockout procedure on defective equipment.

   c. A piece of defective equipment is removed from the operations area.

   d. The surg-tech follows the organization's lockout procedures.

Objective 18

36. What shape is the ordinary combustibles symbol on a fire extinguisher?

   a. triangle

   b. circle

   c. star

   d. square

Objective 8

37. If the health quadrant of the NFPA 704 diamond contained a "4," what would this tell you about the degree of health hazard present?

   a. lowest hazard

   b. highest hazard

   c. moderate hazard

   d. no hazard

Objective 17

38. Into what fire class do the following fuels belong: live electrical equipment, wiring, appliances, and motors?

   a. Class A

   b. Class B

   c. Class C

   d. Class D

Objective 12

39. What should you do if a severe weather watch is announced?

   a. Evacuate the building.

   b. Immediately take shelter.

   c. Prepare to take shelter.

   d. Pull the nearest fire alarm.

Objective 4

40. Which of the following is an example of ergonomics?

    a. body mechanics

    b. good posture

    c. an adjustable desk chair

    d. an MSDS

Objective 7

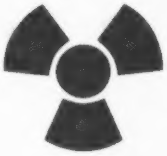
41. What type of hazard does the placard symbol below indicate?

    a. corrosive

    b. infectious

    c. explosive

    d. radioactive



Objective 19

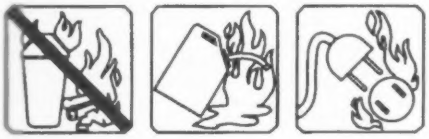
42. According to the portable extinguisher pictographs below, what class fire may this extinguisher be used on?

    a. Class A but not Classes B or C

    b. Class B but not Classes C or A

    c. Classes B and C but not Class B

    d. Classes B and C but not Class A



***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. b
2. b
3. c
4. b
5. c
6. d
7. d
8. b
9. c
10. c
11. a
12. c
13. d
14. b
15. b
16. b
17. a
18. c
19. d
20. d
21. a
22. a
23. d
24. b
25. a
26. c
27. d
28. c
29. b
30. b
31. c
32. d
33. d
34. a
35. a
36. a
37. b
38. c
39. c
40. c
41. d
42. d

# Introduction to Surgical Technology

## SECTION B:
## Safety

### Module 2-B: Workplace Safety

## Module Contents

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Gather the following materials to aid you in illustrating and demonstrating your classroom presentation:
  - OSHA regulations for employers
  - MSDS example
  - Labeled containers of substances commonly used in the operating room
  - Examples of operating room PPE listed in Objective 13
  - Examples of each of the sharps devices listed in Objective 20
  - Tongue depressor or cuticle orangewood stick
  - Sharps box
  - Examples of blunt needles
  - Examples of surgeon's preference cards
  - Health care workplace policies and procedures manual
  - Electrosurgery unit
  - High-powered flashlight
  - Mirror and smooth metal reflective surfaces
  - CPR dummy
  - Different types of eye protection that can be worn when working near lasers

- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Review teacher supplements and make copies of any that will be provided for each student.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss and demonstrate the job sheets. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of these activities and the rating scale that will be used to indicate job performance.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Evaluate the job sheets. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

**Sample A**

4—**Skilled**—Can perform job with no additional training.
3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
1—**Unskilled**—Is familiar with process, but is unable to perform job.
0—**No exposure**—No information or practice provided during training program.

**Sample B**

**Yes**—Can perform job with no additional training.
**No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

- For Objectives 1 and 2, provide students with copies of OSHA regulations required of employers.
- To illustrate Objective 2, show students the location of the workplace MSDS. Review the purposes and information contained on an MSDS.
- Have the workplace Haz Com Officer come to class to speak to the students about the OSHA Haz Com standard, MSDS, and any scheduled training classes for the proper handling, use and storage of chemicals.
- Provide students with and review appropriate Teacher Supplements 1 and 2 when teaching Objective 3 through Objective 9 on workplace violence.
- Have students complete Teacher Supplement 1, "OSHA Workplace Violence Checklist" to identify present or potential violence problems in their school or places of work. Discuss the results of the checklist with the class.
- Provide students with a scenario that will allow them to complete Teacher Supplement 2, "Sample OSHA Violence Incident Report Form."
- Before teaching Objective 11, gather containers of substances commonly used in the operating room, and have students interpret the labels on each. Ask questions about the labels on each container, such as: "What should you do if some of this substance contacts your skin?", "How should you handle spills and leaks?", etc.

- Have a student or students read the basic hospital and surgery workplace safety guidelines in Objective 12. Explain the "why" for each one. "Why should you use good body mechanics?" (*Because you will be more alert and have more stamina if you have good posture and lift and reach properly.*) "Why should you walk and avoid running in the health care facility?" (*To avoid colliding, tripping, or falling accidents, both to ourselves and others.*)

- To illustrate Objective 13, gather examples of PPE. Demonstrate the proper way to don and doff each piece of PPE, explaining when each piece of PPE should be worn and answering student questions when posed.

- Demonstrate the fluid resistance of the three types of surgical gowns by pouring a glass of water on each and allowing students to observe the penetrability/impenetrability of each.

- Review the Key Terms that follow Objective 14.

- For Objective 14, explain the different types of reactions possible on contact with latex. Ask if any student knows if he/she is allergic to or reacts adversely to latex. Record the names of those students and tell them to be sure to pass this information on to their workplace supervisor.

- For Objective 15, review the ways of preventing latex allergy, stressing appropriate work practices to reduce the chance of allergic reactions.

- Before teaching Objectives 16 through Objective 19, find out what students already know (or think they know) about bloodborne pathogens by having them take a brief quiz. Make up your own quiz questions. Go over these objectives very carefully, making sure that the students completely understand the cautions (both in and out of the operating room), prevention, and symptoms of each bloodborne pathogen. When you have covered all four objectives, give the quiz again and again as necessary until all students score 100% on it.

- Show students an example of each sharps device listed in Objective 20.

- When discussing the common causes of needle and scalpel injuries in Objective 21, demonstrate how each can occur. Do not, of course, use the actual needle or scalpel. Use a tongue depressor or cuticle orangewood stick instead.

- When discussing guidelines for handling sharps and sharps boxes, demonstrate (again using a tongue depressor or orangewood stick) applicable guidelines.

- When teaching Objective 23, show students a surgeon's preference card. Also show them examples of each of the categories of blunt needles.

- Demonstrate the guidelines for blunt suturing techniques outlined in Objective 24.

- When teaching Objective 24 through Objective 30, ensure that students understand the differences between Universal Precautions and the newer Standard Precautions. Go over each of the Standard Precautions, demonstrating, explaining and answering questions as necessary.

- Before teaching Objective 27, ask students to list as many substances as they can think of that require hand protection (gloves) per Standard Precautions. Then have them grade their own quizzes as you review the list of substances in Objective 27.

- Do the same thing with Objective 28, quizzing students on instances that require hand washing and then having them grade their quizzes as you review the instances outlined in Objective 28.

- Review the CDC guidelines for proper hand washing outlined in Objective 29. Refer students to Job Sheet 3. Demonstrate proper hand washing procedure. Allow students to return your demonstrations. Schedule a time when students can demonstrate competency of Job Sheet 3.

- Review the guidelines for personal hygiene in the workplace outlined in Objective 30. Provide students with additional specific workplace guidelines as available, or tell them where to find such guidelines in the workplace policies and procedures manual.

- Show students the radiation symbol and different radiation signs. Ensure that students can recognize the difference between a radiation hazard symbol and a fallout shelter symbol.

- When teaching Objectives 31 through 34 on workplace radiation safety invite a workplace radiation safety officer to talk to the class about workplace radiation safety practices.

- Explain the different levels of radiation poisoning exemplified by alpha, beta, and gamma particles.

- For Objectives 35 and 36, take students on a tour of an operating room or storage area of a health care facility containing compressed gas tanks. Point out container colors and safe storage methods. Review the U.S. standard container colors, but caution students that international colors may differ. Caution them also not to rely solely on the color of the container to identify its contents.

- Review the flammable anesthetic gases outlined in Objective 36 and teach the students how to recognize each.

- For Objectives 37 through Objective 41, review common fire ignition sources in the operating room, and then help students differentiate among the burns caused by different sources. Discuss thermal burns in particular, and their possible health-care related causes.

- Explain the hazards of static electricity in the operating room, Objective 40, and proper methods for grounding operating room electrical equipment, Objective 41.

- Discuss safeguards for preventing electrical and fire hazards in the operating room.

- When teaching Objectives 43 through Objective 47 on laser safety, provide many workplace related examples of each laser class.

- Use a high-powered flashlight and a mirror or smooth metal surface to demonstrate specular and diffusive laser beam reflection. Use Teacher Supplement 3 to illustrate the basic biological effects of light on the human eye and skin.

- When teaching Objective 47, take students on a tour of a health care facility operating room, pointing out its conformity to the environmental safety precautions listed in the objective.

- Show students examples of the different types of eye protection that can be worn when working near lasers.

**RESOURCES USED IN DEVELOPING THIS MODULE**

- *American Red Cross Community First Aid and Safety.* St. Louis, MO: Mosby Lifeline, 2002.
- Bledsoe, Brian E., Robert S. Porter, and Richard A. Cherry. *Paramedic Care: Principles & Practice: Vol. 4: Trauma Emergencies.* Upper Saddle River, NJ: Brady/Prentice Hall, 2001.
- *Cleaning Services,* "Module One: Safety, First Aid, Hazard Communications." Stillwater, OK: Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1996.
- Davis, Mark S. *Advanced Precautions for Today's O.R.: The Operating Room Professional's Handbook for the Prevention of Sharps Injuries and Bloodborne Exposures.* Atlanta: Sweinbinder Publications LLC, 1999.
- Ellis, Janice, Elizabeth A. Nowlis, and Patricia M. Bentz. *Modules for Basic Nursing Skills,* Vol I. 6th ed. Philadelphia: Lippincott-Raven Publishers, 1996.
- Ellis, Janice, Elizabeth A. Nowlis, and Patricia M. Bentz. *Modules for Basic Nursing Skills,* Vol II. 6th ed. Philadelphia: Lippincott-Raven Publishers, 1996.
- *Power Product Equipment Technician: Theory and Principles of Engine Operation.* "Basic Workplace Safety and First-Aid Skills." Stillwater, OK: The Multistate Academic and Vocational Curriculum Consortium, Inc., 1996.
- *Workplace Violence: Awareness, Prevention, Response.* Virginia Beach, VA: Costal Human Resources, 1996.

**SUGGESTED SUPPLEMENTAL RESOURCES**

**Print**

- American Medical Association, Young Physicians Section. (1995). *Violence in the Medical Workplace: Prevention Strategies.*
- Bachman, R. (1994). "Violence and Theft in the Workplace." *Crime Data Brief.* U.S. Department of Justice, Bureau of Justice Statistics.
- DiBenedetto, D.V. (1992). "Occupational Hazards of the Healthcare Industry: Protecting Healthcare Workers." *AAOHN* J 43(3), 131–37.
- Metropolitan Chicago Healthcare Council. (1995). Guidelines for Dealing with Violence in Health Care. Chicago, IL.

**Videos**

- *Hazard Communications Right to Know—Nursing.* 9-minute video that meets OSHA requirements for training employees in material safety data sheets, proper labeling of chemicals and hazardous materials. (Item no. 14004A)
- *Updated Bloodborne Pathogens.* 14-minute video updates the bloodborne pathogens standard information, including the Needlestick Prevention Act, and OSHA's enforcement action. (Item no. 1022B)
- *Needlestick Prevention.* 13-minute video designed for anyone using needles or sharp objects in the performance of their job duties. (Item no. 1021B)

- *BBP & Needlestick Prevention for Healthcare Workers*. 10-minute video that surveys the issues of exposure to bloodborne pathogens and prevention of needlestick injuries for the healthcare worker. (Item no. 1024B)

- *Universal Precautions—Infection Control Procedures*. 8-minute video designed for health care providers who normally receive additional universal precautions training. (Item no. 14015A)

Available from:

MAVCC
1500 West Seventh Avenue
Stillwater, OK 74074
800-654-3988
www.mavcc.com

### SUGGESTED WEB SITES*

- http://www.parlay.com

  Instructors may order a safety training Kopy Kit® from this Web site. A Kopy Kit is a collection of reproducible resources: one-page handouts on a variety of topics related to a theme. They are sold in three-ring binders and CD-ROMs so that licensees can easily print, copy, and download the pages onto Intranet and Internet sites. Separate licenses are sold for electronic posting rights. The basic product lines focus on the following three areas:

  — **Health Education**—Patient education and wellness promotion, stress, fitness, nutrition, chronic conditions, weight management, heart health, back care, pregnancy, self-care, life skills, substance abuse and more.

  — **Safety Training**—OSHA compliance and environmental compliance training material on safety awareness, confined spaces, slips and falls, hazcom, PPE, lifting, fire safety, electrical safety, construction safety, warehouse safety, and more.

  — **Productivity Training**—Training and communication resources on teamwork, supervision, customer service, time management, workplace violence, managing work and family, sexual harassment, and more.

- http://www.redcross.org/services/hss/courses/workplace.html

  Programs for the workplace, including prevention of disease transmission

- http://www.osha-slc.gov/OshDoc/data_BloodborneFacts/

  ✔ **NOTE:** OSHA web addresses are case sensitive (notice some of the capital letters in the address) and must be input exactly or you will receive an error message. The address above will take you to the following OSHA fact sheets in PDF format.

  — Protect Yourself When Handling Sharps
  — Personal Protective Equipment Cut Risks
  — Reporting Exposure Incidents
  — Hepatitis B Vaccination—Protection for You
  — Holding the Line on Contamination

- http://www.ASISonline.org

  American Society for Industrial Security series on Preventing Workplace Violence which includes ready-made fact sheets, survey forms and checklists to help organizations guard against workplace violence. Use these flyers to teach the nature and causes of violent behavior, to offer specific tips on identifying those who may become violent and to manage crisis situations when they arise.

- http://www.osha-slc.gov/SLTC/workplaceviolence/

  Complete regulations and guidelines for reducing and preventing health care workplace violence

- http://www.immune.com/rubber/nr3.html#intro

  Contains a good discussion of latex glove allergy

- http://www.va.gov/vasafety/OSH-Issues/LatexAllergy/MainPageLatex.htm

  NIOSH discussion of latex allergy. For additional information about latex allergy, or to request a copy of NIOSH Alert No. 97-135 Preventing Allergic Reactions to Natural Rubber Latex in the Workplace, call 1-800-35-NIOSH (1-800-356-4674). You may also visit the NIOSH home page on the Internet at http://www.cdc.gov/niosh. To access latex allergy Web sites, select Latex Allergy through the NIOSH Web site, or access the Web sites directly at the following addresses:

  http://www.anesth.com/lair/lair.htm
  http://www.familyvillage.wisc.edu/lib_latx.htm

- http://www.osha-slc.gov/

  OSHA announces outreach effort on needlestick prevention. The OSHA Subject Page includes:

  - Needlestick Requirements Take Effect (2001, April 18).
  - News Release (2001, April 12).
  - *Needlesticks Fact Sheet.* (2001, May 9)
  - *Needlesticks FAQ.* (2001, May 9)
  - Needlestick PowerPoint Presentation. (2001, June 14), 1.5 MB PDF.
  - Regulatory Text—New Standard
  - Federal Register—PDF (450 KB)
  - Federal Register—HTML
  - *Preventing Needlesticks.* OSHA JSHQ (Summer 2001) 3.6 MB PDF, 44 pages. Article can be found on pages 12–13, and page 41. New rules affirm the need for safer devices to protect workers.

- http://www.cdc.gov/ncidod/diseases/hepatitis/index.htm

  Hepatitis information from the CDC complete with slide shows, pamphlets, and handouts

- http://www.epa.gov/radiation/students/index.html

  Excellent radiation protection resource kit from the EOA for high school teachers

- http://www.hps.org/publicinformation/radfactsheets/index.html

  Radiation fact sheets and terms

- http://radiationvideos.com

  Radiation safety training video tapes from fundamentals to hospital radiation safety

- http://www.dermatology.org/laser/eyesafety.html

  How to choose eye protection when laser is being used in the operating room

- http://www.medfilms.com/or.htm

  Videotapes on all manner of health care concerns, from lifting safety to operating room fires

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

## Teacher Supplement 1—OSHA Workplace Violence Checklist

**INTRODUCTION**

The following items serve merely as an example of what might be used or modified by employers in health care industries to help prevent workplace violence. This checklist helps identify present or potential workplace violence problems. Employers also may be aware of other serious hazards not listed here. Designated competent and responsible observers can readily make periodic inspections to identify and evaluate workplace security hazards and threats of workplace violence. These inspections should be scheduled on a regular basis; when new, previously unidentified security hazards are recognized; when occupational deaths, injuries, or threats of injury occur; when a safety, health and security program is established; and whenever workplace security conditions warrant an inspection.

Periodic inspections for security hazards include identifying and evaluating potential workplace security hazards and changes in employee work practices which may lead to compromising security. Please use the following checklist to identify and evaluate workplace security hazards. **TRUE notations indicate a potential risk for serious security hazards.**

______ T ______ F This industry frequently confronts violent behavior and assaults of staff.

______ T ______ F Violence occurs regularly where this facility is located.

______ T ______ F Violence has occurred on the premises or in conducting business.

______ T ______ F Customers, clients, or coworkers assault, threaten, yell, push, or verbally abuse employees or use racial or sexual remarks.

______ T ______ F Employees are NOT required to report incidents or threats of violence, regardless of injury or severity, to employer.

______ T ______ F Employees have NOT been trained by the employer to recognize and handle threatening, aggressive, or violent behavior.

______ T ______ F Violence is accepted as "part of the job" by some managers, supervisors, and/or employees.

______ T ______ F Access and freedom of movement within the workplace are NOT restricted to those persons who have a legitimate reason for being there.

______ T ______ F The workplace security system is inadequate—i.e., door locks malfunction, windows are not secure, and there are no physical barriers or containment systems.

______ T ______ F Employees or staff members have been assaulted, threatened, or verbally abused by clients and patients.

______ T ______ F Medical and counseling services have NOT been offered to employees who have been assaulted.

_____ T _____ F Alarm systems such as panic alarm buttons, silent alarms, or personal electronic alarm systems are NOT being used for prompt security assistance.

_____ T _____ F There is no regular training provided on correct response to alarm sounding.

_____ T _____ F Alarm systems are NOT tested on a monthly basis to assure correct function.

_____ T _____ F Security guards are NOT employed at the workplace.

_____ T _____ F Closed circuit cameras and mirrors are NOT used to monitor dangerous areas.

_____ T _____ F Metal detectors are NOT available or NOT used in the facility.

_____ T _____ F Employees have NOT been trained to recognize and control hostile and escalating aggressive behaviors, and to manage assaultive behavior.

_____ T _____ F Employees CANNOT adjust work schedules to use the "buddy system" for visits to clients in areas where they feel threatened.

_____ T _____ F Cellular phones or other communication devices are NOT made available to field staff to enable them to request aid.

_____ T _____ F Vehicles are NOT maintained on a regular basis to ensure reliability and safety.

_____ T _____ F Employees work where assistance is NOT quickly available.

## Teacher Supplement 2—Sample OSHA Violence Incident Report Form

## SAMPLE

*The following items serve merely as an example of what might be used or modified by employers in these industries to help prevent workplace violence.*

(Sample/Draft—Adapt to your own location and business circumstances.)

**Confidential Violence Incident Report Form**

A reportable violent incident should be defined as any threatening remark or overt act of physical violence against a person(s) or property whether reported or observed.

1. Date: ____________________ 2. Specific Location:
Day of week: ____________________
Time: ____________________
Assailant: Female ________ Male ________

3. Violence directed towards: ______Patient ______Staff ______Visitor ____Other
Assailant: ______Patient ______Staff ______Visitor ____Other
Assailant's Name: ____________________
Assailant: ______Unarmed ______Armed (weapon) ____________

4. Predisposing factors:
________Intoxication ________ Dissatisfied with care/waiting time
________Grief reaction ________ Prior history of violence
________Gang related
________ Other (Describe) ____________________

5. Description of incident:
________Physical abuse
________Verbal abuse
________ Other (Describe) ____________________

6. Injuries:
________Yes ________ No

7. Extent of injuries:
____________________
____________________
____________________

8. Detailed description of the incident:

________________________________________________

________________________________________________

________________________________________________

9. Nature of the incident: (Check all applicable boxes.)

____ Assaults or violent acts: ____Type "1" ____Type "2" ____ Type "3" ____Other

____ Preventative or warning report

____ Bomb or terrorist type threat (special checklists attached ☐ Yes ☐ No)

____ Transportation accident

____ Contacts with objects or equipment

____ Falls

____ Exposures

____ Fires or explosions

____ Other

10. Legal counsel advised of incident ☐ Yes ☐ No EAP advised: ☐ Yes ☐ No

11. Did any person leave the area because of incident?
________Yes __________ No ________ Unable to determine

12. Present at time of incident:
________Police ______________________ Department
________Hospital security officer

13. Needed to call:
________Police ______________________ Department
________Hospital security officer

14. Termination of incident:
Incident diffused ______Yes ________No
Police notified ______Yes ________No
Assailant arrested ______Yes ________No

15. Disposition of assailant:
________Stayed on premises
________Escorted off premises
________Left on own
________Other (Describe) __________________________________

16. Restraints used:
________Yes __________ No __________________ Type

17. Number of persons affected ____________

(For each person complete a report; however, to the extent facts are duplicative, any person's report may incorporate another person's report.)

18. Name of affected person(s) ____________ Service date ____________

Position: ____________ member of labor organization ________ ☐ Yes ☐ No

Supervisor: ____________ has supervisor been notified ☐ Yes ☐ No

Family: ____________ has been notified by ____________ ☐ Yes ☐ No

19. Lost work time ☐ Yes ☐ No

Anticipated return to work ____________

Third parties or nonemployee involvement ☐ Yes ☐ No (include contractor and lease employees, visitors, vendors, customers)

20. OSHA log or other OSHA action required ☐ Yes ☐ No

21. Incident Response Team:

____________

____________

____________

22. Team Leader ____________ ____________

*Signature* *Date*

23. Report completed by: ____________ Title: ____________

Witnesses: ____________

Supervisor notified: ____________ Time: ____________

**Please put additional comments, according to numbered section, on reverse side of form.**

## Teacher Supplement 3—Basic Biological Effects of Light

| Photobiological Spectral Domain | | Eye Effects | Skin Effects |
|---|---|---|---|
| Ultraviolet C | (0.200–0.280 μm) | Photokeratitis | Erythema (sunburn)<br>Skin Cancer<br>Accelerated Skin Aging<br>Increased Pigmentation |
| Ultraviolet B | (0.280–0.315 μm) | | |
| Ultraviolet A | (0.315–0.400 μm) | Photochemical UV Cataract | Pigment Darkening |
| Visible | (0.400–0.780 μm) | Photochemical & Thermal Retinal Injury | Photosensitive Reactions |
| Infrared A | (0.780–1.400 μm) | Cataract, Retinal Burns | Skin Burn |
| Infrared B | (1.400–3.000 μm) | Corneal Burn<br>Aqueous Flare<br>IR Cataract | |
| Infrared C | (3.000–1000 μm) | Corneal Burn Only | |

## Teacher Supplement 4—Emergency Management

**INTRODUCTION**

There are many crisis situations that necessitate emergency planning and response in schools today. For example, a weather-related disaster such as a tornado could occur, a student could carry a gun to school, or a bomb threat could be made. It is imperative that schools be able to respond to an emergency and regain stability as quickly as possible. In order to regain this stability, schools must have an emergency response/management plan in place.

✔ **NOTE:** Following are some of the issues involved in emergency management.

- **Following a crisis:**
  - As soon as possible following a crisis, the crisis intervention team should be briefed. Any outside contact with the media should be made through the designated media spokesperson. A plan/policy for dealing with the media should be created prior to a traumatic event so steps will already be in place for the media spokesperson to follow.
  - Before faculty/staff meet with their students, a meeting should be held to share information regarding the event and what information is appropriate to discuss with their students. Once the faculty and staff have been debriefed, they should meet with their students to share facts surrounding the crisis, normal reactions to crisis, the plan of action for the day/week, resources available to them, and how they can be involved in the response plan. Some students may need more one-on-one counseling, especially if they knew the victim(s) well or were directly involved in the traumatic event. The "drop-in" room should be established for students who wish to speak to a counselor directly.
    - Drop-in rooms for students and staff
      - Quiet area(s) should be established within the first twenty-four hours of an emergency where students and staff can come for one-on-one crisis intervention and time for quiet grieving.
      - Counselors should be present in room(s) at all times.
      - Drop-in room(s) should be available for several days following the crisis.

    ✔ **NOTE:** Students and staff who continue to have intense traumatic stress reactions should be referred to another mental health resource for individual counseling.

  - Days 2 through 6 following the traumatic event should focus on how the traumatic event is impacting the school. This includes meetings of the crisis intervention team to update one another on status of their area of responsibility, information meetings of faculty/staff to discuss classroom behavior, school routines, and communication with parents.

- Common signs and symptoms of traumatic stress reactions:
    - Victims of traumatic events often suffer a wide variety of reactions. These reactions can include the following:
        - physical reactions such as nausea, dizziness, chest pain, sleep problems, or
        - emotional reactions such as fear, guilt, anxiety, grief, or
        - behavioral reactions such as pacing, erratic movements, changes in behavior, or
        - cognitive reactions such as thinking difficulty, nightmares, poor attention span, etc.

    ✔ **NOTE:** The signs and symptoms listed above are only a few of the possible traumatic stress reactions that people can display. Consult your local mental health provider for a complete list of traumatic stress reactions.

➤ Days 6 and on are considered the integration phase. By this time the majority of the school community will have reached closure and will moved past the traumatic event. Those faculty/staff members and students who are unable to move on should be directed to appropriate counseling services.

➤ A school assembly or memorial may be held at some point following the traumatic event, if appropriate. This type of meeting can be used to process and put closure on many traumatic issues.

➤ The final task of the crisis intervention team is to evaluate the intervention process. Any changes that need to be made to the emergency management process should be reviewed and made at this time. The team may also wish to suggest curriculum activities to be integrated into the classroom to help integrate the trauma of the past, normalize resulting responses, and prepare individuals for future life events that may produce trauma.

# Teacher Supplement 5—Youth Violence

## Some of the Latest Ideas

- The media has much to do with the perceptions developed by people—much is over-dramatized, so that the grief and suffering is prolonged or exacerbated—teens, in particular, will take on the emotional crisis of others and amplify it.
- The disaffected, outcast student is the common thread in most of these incidents.
- The students involved in violent incidents all showed recognizable signs prior to the incident.
- We should be prepared and cautious, not paranoid.
- Use a proactive approach rather than reactive.

## Effects of Cliques and Social Groups on Teens

- What are the various social groups that young people divide themselves into?
- What do the students in each of these groups look like? How do they dress and how do they act?
- You should know these groups and be able to recognize which one a student fits into—this can be important information, and it is essential to the teen.
- Who are the "popular" students? WHY are they the popular students? This can have much to do with the anger and outcast feelings some students experience.
- Are your students getting fair treatment from other students and you? Teachers often have their favorites and students realize it.
- Teens think of themselves as unique and different—it is often a great insult to tell a teen they are like everyone else, even though it might be true.
- The fiery need for individuality is often a precursor to the rage within, because teens really want to be accepted—it is a dichotomy teens cannot recognize and it causes a great emotional struggle.
- Accept a teen for how they see themselves at the moment—remember that adolescence is a "trying out" period.

- **Recognizing Potential for Student Violence**
    - You are with the student for three hours each day—perhaps the longest "quality" connection a teen gets on a daily basis.
    - Keep your eyes and ears open.
    - Has a student's dress/look changed recently? Hairstyle, makeup, piercings, tattoos, etc.
    - What about their circle of friends?
    - Any change in behavior? Attitude, listlessness, withdrawn, depressed, unusual mood swings (even more so than normal for a teen), anger, talk of vengeance, and poor self-image.
    - Have grades dropped recently?
    - Are there problems at home?
    - What is the student carrying with them? Any unusual items?
    - What is written on their book covers, papers, clothes, and even skin?
    - Who is picked on in class? Why are they being picked on? What can you do to alleviate the situation?
    - Who are the bullies in your class? Take extra time to mitigate their activity. It is your responsibility to protect students and provide them a safe environment in which to learn.
    - Bullying can be merciless and is often based on petty social agendas, such as a person's appearance, their choice of friends, the things they like to do, etc.
    - Each of the students involved in recent violent acts said that there was some sort of bullying, teasing, or ostracism. What will you do to keep it from happening? This can be a major causative factor in violence.
    - Do not be afraid to report a student for comments that are, or may be interpreted as, threats of violence to another—your safety can depend on it! Good intelligence can lead to a good solution and good prevention. Remember, we are responsible if we fail to act!
    - Most acts of school violence occur in the Spring semester, especially when the weather gets warmer—be particularly cautious at this time of year.
- **What Instructors Should Do if Violence Occurs**
    - Think safety first! You have the charge of a group of young people and need to think of their safety and your safety first!
    - Take cover! If an incident occurs in your classroom, or nearby, where can you take your students to protect them? Find the safest room, closet, or area that is **out of sight**.

- Most likely, you will not hear any general alarms or "lockdown" signals, especially if your campus is widespread and such a signal could cause general panic or startle the offender into more violence.

- If a violent situation occurs elsewhere on campus, emergency response team members will come to your classroom to tell you what to do. This will facilitate whether the need is to take cover or to evacuate.

- If confronted with violence, try to calm the offender and keep yourself cool as best you can. Assure them that you will cooperate and help them. There is no magic answer to any violent situation, so no one can guarantee that you or your students will not be harmed. It will have to be a judgement call on your part. Remember, it is chaotic and filled with fear. Anything you can do to bring calm and orderliness will help. Some people will take action, and some will freeze.

- The reality of violence and death is much more horrible than the movies or video games demonstrate. It will end quickly, but seem to take forever. The resulting trauma can be worse than the wounds.

## Written Test

Name ____________________________________________

Date ______________________ Score ______________________

**OBJECTIVE 1** Describe three of the OSHA regulations required of employers.

a. ____________________________________________

____________________________________________

b. ____________________________________________

____________________________________________

c. ____________________________________________

____________________________________________

**OBJECTIVE 2** Complete statements concerning OSHA and its role in workplace health and safety. Write your answers on the blank lines provided in the statements below.

a. Became federal law on April 28, __________

b. Operates under the ______________________

c. Sets two major requirements for employers:

- To furnish each employee a place of employment free from recognized hazards that are likely to cause ________ or ____________
- To comply with the occupational safety and health standards contained within __________ regulations

d. Sets one major requirement for employees:

- To comply with occupational safety and health standards and all rules, regulations, and orders pursuant to OSHA regulations that are applicable to the employee's own __________ and __________

e. Requires employers to keep records of their employees' occupational ____________ and ____________

f. Requires employers to keep ______________________ on all hazardous substances used by employees

g. Often sets only ____________ standards and requirements

h. Provides for federal OSHA officers who visit facilities and levy penalties for ______________________

**OBJECTIVE 3** Complete statements concerning OSHA risk factors for violence to health care workers. Write your answers on the blank lines provided in the statements below.

Health care and social service workers face an increased risk of work-related assaults stemming from several factors, including:

a. The prevalence of handguns and other weapons—as high as ________ percent—among patients, their families, or friends.

b. The increasing use of ________________ by police and the criminal justice systems for criminal holds and the care of acutely disturbed, violent individuals.

c. The increasing number of acute and chronically ____________________ patients now being released from hospitals without followup care, who now have the right to refuse medicine and who can no longer be hospitalized involuntarily unless they pose an immediate threat to themselves or others.

d. The availability of ______________ or money at hospitals, clinics, and pharmacies, making them likely robbery targets.

e. Situational and circumstantial factors such as

- ________________ movement of the public in clinics and hospitals;
- The increasing presence of gang members, drug or alcohol abusers, trauma patients, or distraught family members;
- Long waits in emergency or clinic areas, leading to client frustration over an inability to obtain needed services promptly.

f. ____________ staffing levels during times of specific increased activity such as meal times, visiting times, and when staff are transporting patients.

g. ________________ work with clients during examinations or treatment.

h. ______________ work, often in remote locations, particularly in high-crime settings, with no back-up or means of obtaining assistance such as communication devices or alarm systems.

i. Lack of staff training in recognition and ___________________ of escalating hostile and assaultive behavior.

**OBJECTIVE 4** Name the four main components to any effective safety and health program that also apply to preventing workplace violence. Write your answers on the blank lines provided below.

a. ______________________________________________

b. ______________________________________________

c. ______________________________________________

d. ______________________________________________

**Objective 5** List three of the responsibilities of management in creating an effective workplace violence prevention program. Write your answers on the blank lines provided below.

a. ______________________________

______________________________

b. ______________________________

______________________________

c. ______________________________

______________________________

**Objective 6** List two of the responsibilities of employees in creating an effective workplace violence prevention program. Write your answers on the blank lines provided below.

a. ______________________________

______________________________

b. ______________________________

______________________________

**Objective 7** Complete statements concerning OSHA-recommended engineering controls and workplace adaptation that can effectively prevent or control workplace violence hazards. Write your answers on the blank lines provided in the statements below.

a. Assess any plans for new ________________ or physical changes to the facility or workplace to eliminate or reduce security hazards.

b. Install and regularly maintain __________ systems and other security devices, panic buttons, hand-held alarms or noise devices, cellular phones, and private channel radios where risk is apparent or may be anticipated, and arrange for a reliable response system when an alarm is triggered.

c. Provide ______________________—installed or hand-held, where appropriate—to identify guns, knives, or other weapons, according to the recommendations of security consultants.

d. Use a closed-circuit video recording for high-risk areas on a ____-hour basis.

e. Place ___________________ at hallway intersections or concealed areas.

f. _______________ nurses' stations, and install deep service counters or bullet-resistant, shatter-proof glass in reception areas, triage, admitting, or client service rooms.

g. Provide employee "________ rooms" for use during emergencies.

h. Establish "________________" or seclusion areas with high ceilings without grids for patients acting out, and establish separate rooms for criminal patients.

i. Provide client or patient ______________ rooms designed to maximize comfort and minimize stress.

j. Ensure that counseling or patient care rooms have ________ exits.

k. Limit access to staff counseling rooms and treatment rooms controlled by using ______________ doors.

l. Arrange furniture to prevent ________________ of staff.

m. Limit the number of pictures, vases, ashtrays, or other items that can be used as ________________.

n. ____________ all unused doors to limit access, but only in strict accordance with local fire codes.

**OBJECTIVE 8**

Complete statements concerning OSHA-recommended administrative and work practice controls to help prevent workplace violence. Write your answers on the blank lines provided in the statements below.

a. State clearly to patients, clients, and employees that ______________ is not permitted or tolerated.

b. ____________ all incidents of violence.

c. Require employees to report all ______________ or ______________ to a supervisor or manager.

d. Keep ______________ and ________________ of all assaults or threats to help in determining any necessary actions to prevent further occurrences.

e. Set up a trained __________________ team to respond to emergencies.

f. Use properly trained ______________________, when necessary, to deal with aggressive behavior; follow written security procedures.

g. Institute a ____________ procedure with passes for visitors, especially in a newborn nursery or pediatric department.

h. Establish a list of "______________ visitors" for patients with a history of violence.

i. Establish ________________ and _________________ for secured areas, and emergency evacuations, and for monitoring high-risk patients at night.

j. Ascertain the ______________________ of new and transferred patients to learn about any past violent or assaultive behaviors.

k. Transfer _____________ clients to "acute care units," "criminal units," or other more restrictive settings.

l. Discourage employees from wearing _____________ to help prevent possible strangulation in confrontational situations.

m. Provide staff members with _____________________ to parking areas in evening or late hours.

n. Use the "________ system," especially when personal safety may be threatened.

o. Develop ____________ and ______________covering home health care providers, such as contracts on how visits will be conducted, the presence of others in the home during the visits, and the refusal to provide services in a clearly hazardous situation.

p. Establish a daily ________________ for field staff to keep a designated contact person informed about workers' whereabouts throughout the workday.

q. Conduct a comprehensive ________________________________, including psychological as well as medical treatment, for employees who have been subjected to abusive behavior.

**OBJECTIVE 9** List three records that are important to the success of a workplace violence prevention program. Write your answers on the blank lines provided below.

a. ______________________________________________________________

______________________________________________________________

b. ______________________________________________________________

______________________________________________________________

c. ______________________________________________________________

______________________________________________________________

**OBJECTIVE 10** Select true statements concerning hazard communications. Write a "T" on the blanks next to the true statements.

_____ a. OSHA requires employees rather than employers to develop a written Haz Com program.

_____ b. Material safety data sheets should be readily available to all employees.

_____ c. Employees should be trained on the proper handling, usage, storage, and transportation of chemicals.

_____ d. OSHA established the Haz Com Standard to protect employers from lawsuits.

_____ e. The Haz Com standard ensures the employees "right to know" about potentially dangerous chemicals in the workplace.

**OBJECTIVE 11** Select true statements concerning the information on a chemical label. Write a "T" on the blanks next to the true statements.

_____ a. Chemical labels contain the chemical name and the chemical ingredients.

_____ b. The name, address, and phone number of the manufacturer or distributor should be located on the chemical label.

_____ c. A chemical label will NOT contain information on how to handle spills and leaks. For this information, go to the MSDS.

_____ d. Procedures for safe use, handling, storage, and disposal are located on the chemical label.

_____ e. Signal words that identify the chemical's hazard level include caution for most severe, warning for least severe, and danger for very severe.

_____ f. Critical first-aid instructions and type of fire extinguisher to use are included on the chemical label.

_____ g. Personal protective equipment to wear when using the chemical is found on the chemical label.

**OBJECTIVE 12** Complete basic healthcare workplace safety guidelines. Write your answers on the blank lines provided in the statements below.

a. Use good body ____________________.

b. ____________________; avoid running.

c. Keep to the ____________________ in hallways.

d. Turn corners carefully, slowing and checking ceiling ______________ on intersecting walls.

e. Open doors ________________, checking the other side of swinging doors that have glass inserts.

f. Use stretchers properly.

- ______________, don't ______________, the stretcher.
- Keep patient's ____________________ toward your body.
- Keep your eyes to the _______________ at all times.

g. Use ________________ on beds, wheelchairs, and stretchers.

h. Place elevators on ____________ when loading and unloading.

i. When handling an occupied wheelchair, ____________ into the elevator, _______________ the wheelchair in _______________ you.

j. Never manually ________________ contaminated needles.

**OBJECTIVE 13**

Match personal protective equipment (PPE) to their protective requirements. Write the numbers on the blanks provided.

_______ a. Must be uniform, effective and worn by all O.R. personnel

_______ b. Select to match the expected degree of exposure

_______ c. Must effectively repel blood and body fluids

_______ d. Have become popular for orthopedic procedures because blood spatters and bone chips created by power tools present a special hazard

_______ e. Include fluid-resistant, strike through, and impervious types that should be selected to match the expected degree of exposure

_______ f. Routinely double-glove and, if necessary to protect the cuff area, wear elbow-length gloves when significant or massive blood loss and prolonged duration is expected

_______ g. May be an appropriate additional precaution in cases where the patient is a known carrier of bloodborne pathogens

_______ h. Fluid-resistant types are helpful in preventing exposures; trauma boots are appropriate for obstetrical procedures and other procedures that pose a high risk of exposure to bloodborne pathogens

1. Eye and face protection
2. Footwear/shoe covers
3. Hand protection
4. Headwear
5. Neckwear
6. "Space suits"
7. Surgical drape selection
8. Surgical gowns

**OBJECTIVE 14**

Match major types of reactions to latex to their characteristics. Reactions may be used more than once. Write the numbers on the blanks provided.

_______ a. Is a systemic allergic reaction usually occurring within 30 minutes of exposure and caused by circulating IgE antibodies to the proteins in natural latex

_______ b. Can be caused by frequent hand washing and inadequate drying, aggressive scrubbing technique or detergents, mechanical abrasive effect of glove powder, climatic irritation, or emotional stress

_______ c. Is not life threatening, but those with this type of allergy are at increased risk to develop other type of allergy

_______ d. Can cause breaks in the skin which can allow easier entry of the sensitizing latex protein or glove chemicals, and in turn lead to latex allergy

_______ e. Is a contact dermatitis (hand) typically seen 6 to 48 hours after contact and generally due to the chemicals used in latex glove production

_______ f. Can exhibit such symptoms as hives, rhinitis, conjunctivitis, asthma due to bronchoconstriction, and in severe cases anaphylaxis and hypotension

_______ g. Is a skin irritation that does not involve the body's immune response, so is not an allergic response

_______ h. Includes the following exposure routes: cutaneous, mucosal, parenteral, and aerosol

1. Delayed cutaneous hypersensitivity
2. Immediate reaction
3. Irritant dermatitis

**OBJECTIVE 15**

List three ways of preventing latex allergies. Write your answers on the blank lines provided below.

a. ____________________________________________

____________________________________________

b. ____________________________________________

____________________________________________

c. ____________________________________________

____________________________________________

**OBJECTIVE 16**

Complete statements concerning bloodborne pathogens. Write your answers on the blank lines provided in the statements below.

a. Bloodborne pathogens are microorganisms in the bloodstream that can cause ____________________.

b. The most common bloodborne pathogens that concern operating room professionals are hepatitis B, hepatitis C, and ____________________.

c. Bloodborne pathogens are found in ____________________________.

d. In order for an infection to occur, both the source blood must be ______________, and that blood must enter another person's bloodstream.

e. Infections can occur if infected blood enters a person's bloodstream through any of the following routes: unprotected opening in the ____________ such as cuts, scrapes, and dermatitis; unprotected _________ _____________ openings such as the eyes, nose, and mouth; penetration into the ___________ by a sharp object such as a broken glass, a needle or knife blade.

**OBJECTIVE 17**

Select true statements concerning the five different types of hepatitis. Write a "T" on the blanks next to the true statements.

_____ a. Hepatitis A (HAV) is caused by the hepatitis A virus and can affect anyone.

_____ b. Hepatitis C (HCV) can be prevented by a vaccination.

_____ c. Hepatitis D (HDV) is a defective virus that needs the hepatitis A virus to exist.

_____ d. Hepatitis E (HEV) occurs only in the United States.

_____ e. HEV is associated with fecal-oral route and fecally contaminated drinking water in most outbreaks.

_____ f. HBV can be symptomless, infected persons carrying the disease and infecting others without knowing it.

_____ g. HAV can be prevented in the short-term by receiving immune globulin.

_____ h. HAV can be prevented by using good personal hygiene and proper sanitation.

_____ i. Hepatitis B (HBV) can cause lifelong infection, cirrhosis of the liver, liver cancer, liver failure, and death.

_____ j. HDV can lead to chronic liver disease and cirrhosis of the liver.

_____ k. HEV is contracted most often through person-to-person transmission.

**OBJECTIVE 18**

Select true statements concerning common bloodborne pathogens and their concern to operating room professionals. Write a "T" on the blanks next to the true statements.

_____ a. Human immunodeficiency virus (HIV) is caused by sharps injuries in more than 80% of occupationally acquired cases.

_____ b. HCV requires that all operating room professionals be vaccinated with HCV vaccine.

_____ c. HBV can live up to seven days on dry surfaces.

_____ d. HIV permits opportunistic infections, malignancies, and neurologic diseases to attack the body.

_____ e. HCV is harbored by 50% of emergency room patients.

_____ f. HCV has an extremely low rate of chronic infection.

_____ g. There is a 6% to 30% risk of acquiring HBV from a needlestick injury with HBV-contaminated blood.

_____ h. Because HIV is a mutating virus, researchers have been unable to find a cure or vaccine.

_____ i. HBV has a high mortality rate.

_____ j. About 20% of patients chronically infected with HCV develop end-stage cirrhosis, liver failure, and liver cancer.

**OBJECTIVE 19** Complete a chart comparing HIV and HBV. Write your answers on the blank lines provided in the chart below.

| | HIV | HBV |
|---|---|---|
| Transmission | Sexual contact<br>Parenteral<br>a. ________________ | Sexual contact<br>Parenteral<br>b ______________ |
| Incubation | c. ___ - ___ days to get through bloodstream<br>2 weeks to 2 months to show positive test<br>e. Up to ______ + years symptomatic | d. ____ - ___ days |
| Symptoms | HIV + (asymptomatic)<br>ARC flu symptoms<br>Aids opportunistic diseases | f. _______ of patients asymptomatic<br>Flu symptoms<br>g. Acute ___________ |
| Prognosis | h. __________________ | i. Complete recovery, ______ months<br>Chronic carrier<br>Complications such as<br>¥ Cirrhosis<br>¥ Liver cancer<br>¥ Chronic liver disease<br>j. ______________ |

**OBJECTIVE 20** List seven examples of devices that can cause sharps injuries. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

**OBJECTIVE 21** List five common causes of suture needle and scalpel injuries. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

**OBJECTIVE 22** Complete guidelines for handling sharps and sharps boxes. Write your answers on the blank lines provided in the statements below.

a. Use a ____________ Zone.

b. Mount and remove scalpel blades and needles with safety devices designed for that purpose or with a hemostat—never with the ____________.

c. Use extreme care when assembling or dismantling devices with sharp components that require the use of both hands and an opposing ______________ method.

d. Avoid recapping needles by directly _________________ of them.

e. Place the sharps container within ______ __________ of work area.

f. Keep both hands ________________ the needle or scalpel.

g. Ensure that the opening of the sharps container is _________________.

h. Avoid __________________ the sharps container.

i. _____________ reach into a sharps disposal container—either with fingers or instruments.

**Objective 23**

Match blunt needle categories to their selection guidelines. Write the numbers on the blanks provided.

_______ a. Require a little more effort to penetrate tissue such as fascia; may be chosen for fascial closure and for increased protection of the gloves and fingers when operating on patients with known bloodborne pathogens

_______ b. Work well for most applications, with the exception of bowel anastomosis

_______ c. Do not penetrate tissue such as the fascia easily and should not be used for this purpose; may be appropriate in unusual situations in pelvic and abdominal surgery where the needle absolutely must be retrieved with the fingers

1. Extremely blunt needles
2. Intermediate blunt needles
3. Least blunt needles

**Objective 24**

Complete guidelines for safe blunt suturing techniques. Write your answers on the blank lines provided in the statements below.

a. Use a strong needle holder and fully activate the _______________.

b. Mount the needle in the _____________ rather than three-quarters of the way back, to prevent slippage or bending of the needle.

c. __________ and stabilize the tissue to be sutured to facilitate needle penetration.

d. Avoid ___________ handling of any and all suture needles, whether blunt or sharp.

e. Know that blunt GI needles made of thin-gauge wire with a thin point can cause ______________ injury if a blow to the skin is delivered with force.

f. Know that blunt needles of general closure size, especially those with _______________ blunt points, can cause a puncture if a blow to the skin is delivered with force.

g. Avoid needle breakage, by not using _______-gauge needles with dense tissue.

h. Carefully read labels on suture packs to verify that ___________ rather than ____________ needles were pulled.

**Objective 25**

Explain the differences between Universal Precautions and Standard Precautions. Write your answers on the blank lines provided below.

a. Universal Precautions— ______________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

b. Standard Precautions— ______________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

**Objective 26** Complete statements concerning Standard Precautions. Write your answers on the blank lines provided in the statements below.

a. Wear clean __________ or __________ gloves whenever there is potential for contact with body fluids or any moist body surface.

b. Know the specific situations in which gloves are recommended by the CDC because the potential for contact with body substances is high.

- Performing _____________
- Performing __________ or ___________ sticks in infants and children
- Performing procedures involving contact with ________ __________ and diagnostic procedures that do not require sterile gloves
- Changing or manipulating ___ _________ when blood contamination is possible
- Handling dressings soiled with body fluids
- Handling urine or feces
- Providing care (such as perineal care) that could result in contact with moist surfaces of body fluids

c. Change gloves between ___________ contacts.

d. Do not ________ or ___________ examination gloves.

e. Wash your hands thoroughly

- Immediately after accidental contact with body _________ or ________ body surfaces,
- Between patients, and
- Immediately after removing gloves.

f. Wear a __________ and protective eyewear or a ____ __________ to protect the mucous membranes of your mouth, nose, and eyes during procedures that may generate droplets or splashes of any body fluid.

g. Wear a disposable moisture-proof __________ or __________ during procedures likely to generate splatters of body fluid or soil your clothing.

h. Dispose of equipment and secretions properly

- Sharps in __________ _____________;
- Bulk blood, suctioned fluids, and excretions down _________ to ___________.

i. Put all ______________ in moisture-proof containers with secure lids to prevent leakage during transport, taking care to prevent contaminating the outside of the container to protect those who will handle the container.

j. Handle soiled linen correctly.

- Hold away from your uniform,
- Do not shake or toss, and
- Place and transport linen soiled with body fluids in leakage-resistant ______________.

k. Follow your facility's ______________ for cleaning contaminated surfaces and materials and for disposing of infective wastes.

l. Clean visible ___________ from objects and surfaces before disinfection.

m. Use a commercial ________________ solution for cleaning.

n. Use ____________________, resuscitation bags, or other ventilation devices for CPR whenever possible.

o. If you have a ______________, refrain from all direct patient care and from handling patient care equipment until the ____________ is resolved.

**OBJECTIVE 27** Identify eight substances included in Standard Precautions that require hand protection (gloves). Write your answers on the blank lines provided below.

a. ______________________________________________
b. ______________________________________________
c. ______________________________________________
d. ______________________________________________
e. ______________________________________________
f. ______________________________________________
g. ______________________________________________
h. ______________________________________________

**OBJECTIVE 28** List four instances that require hand washing. Write your answers on the blank lines provided below.

a. ______________________________________________
b. ______________________________________________
c. ______________________________________________
d. ______________________________________________

**OBJECTIVE 29**

List five CDC guidelines for proper hand washing. Write your answers on the blank lines provided below.

a. ______________________________________________

b. ______________________________________________

c. ______________________________________________

d. ______________________________________________

e. ______________________________________________

**OBJECTIVE 30**

Select true statements concerning guidelines for personal hygiene in the workplace. Write a "T" on the blanks next to the true statements.

_____ a. It is acceptable to wear your hair long even if it falls in your face.

_____ b. Keep your fingernails clean and trimmed or filed short.

_____ c. If you use polish, ensure that it is intact; chipped polish provides a place for bacteria to lodge.

_____ d. It is acceptable to wear necklaces and hoop earrings.

_____ e. Do not wear eyebrow, nose, tongue or other body piercing jewelry.

**OBJECTIVE 31**

Complete statements concerning the characteristics of radiation. Write your answers on the blank lines provided in the statements below.

a. Radiation waves and particles are used therapeutically for diagnosis and treatment of ________________.

b. Exposure to ______________ radiation should be limited because it has the ability to penetrate cells and change them.

c. Radiation effects are directly related to the __________ and ___________ of exposure.

d. The effects of radiation exposure may not become evident for _________.

e. ________________ to radiation can result in illnesses ranging from the mild to lethal.

f. The universal symbol used to identify radioactive materials, containers, and storage areas is a ___________ or ___________ propeller on a ____________ background.

**OBJECTIVE 32** Match the three types of ionizing radiation to their characteristics. Write the numbers on the blanks provided.

______ a. Cannot be stopped by a sheet of paper, and though some can be stopped by human skin, others need a thicker shield to stop them

______ b. The most penetrating of the three types of radiation

______ c. Can be prevented from penetrating the body by a sheet of paper or by human skin

1. Alpha
2. Beta
3. Gamma

**OBJECTIVE 33** Describe radiation safety practices.

a. Patient safety— ______________________________

______________________________

______________________________

______________________________

______________________________

b. Personnel safety— ______________________________

______________________________

______________________________

______________________________

______________________________

**OBJECTIVE 34** State three of the conditions that require immediate notification of the health care facility radiation safety officer.

a. ______________________________

______________________________

b. ______________________________

______________________________

c. ______________________________

______________________________

**OBJECTIVE 35** Match compressed gases to their traditional U.S. cylinder colors. Write the numbers on the blanks provided.

_______ a. Gray

_______ b. Black

_______ c. Blue

_______ d. Brown

_______ e. Yellow (black and white, international)

_______ f. Green (white, international)

_______ g. Orange

1. Air
2. Carbon dioxide
3. Cyclopropane
4. Helium
5. Nitrogen
6. Nitrogen oxide
7. Oxygen

**OBJECTIVE 36** List the flammable anesthetic gases. Write your answers on the blank lines provided below.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

d. ____________________________________________

e. ____________________________________________

**OBJECTIVE 37** Select from the following list the three most common fire ignition sources in the operating room. Write an "X" on the blanks next to the correct ignition sources.

_____ a. Lasers

_____ b. Cotton drapes

_____ c. High intensity light cords

_____ d. Electrosurgical/Cautery equipment

_____ e. Oxygen tanks

_____ f. Prep solutions

_____ g. Synthetic drapes

**OBJECTIVE 38**

Match types of burns to their descriptions. Write the numbers on the blanks provided.

______ a. Contact with corrosive or irritating chemicals such as acids or alkalines

______ b. Overexposure to radiant energy

______ c. Resulting from overexposure to electricity

______ d. Contact with fire, hot objects, or hot fluids

1. Chemical
2. Electrical
3. Radiation
4. Thermal

**OBJECTIVE 39**

Discuss at least two possible health-care related causes of patient thermal burns. Write your answers on the blank lines provided below.

a. ______________________________________________

______________________________________________

b. ______________________________________________

______________________________________________

**OBJECTIVE 40**

Select true statements concerning static electricity. Write a "T" on the blanks next to the true statements.

_____ a. Static electricity is a rare hazard in the O.R.

_____ b. Static electricity causes patient shocks and burns.

_____ c. Static electricity produces a spark which can ignite materials in oxygen rich atmosphere of the O.R.

_____ d. Static electricity develops from friction and accumulates on physical objects.

_____ e. When two static-bearing objects come in contact, the one bearing the higher potential discharges to the one with the lower potential.

_____ f. An electrostatic charge or spark between two objects can occur only when there is no pathway of conductivity between them. Therefore, the chief aim is to provide a manner of dissipating the static accumulation.

_____ g. A good conductive floor prevents the accumulation of static electricity by providing a pathway of conductivity between all persons and equipment coming in contact with it.

_____ h. Oils, waxes, and detergents increase the conductivity of floors and should always be used in the operating room.

**OBJECTIVE 41**

Complete statements concerning grounding operating room electrical equipment. Write your answers on the blank lines provided in the statements below.

a. All electrical equipment, including ____________________, must be grounded to prevent the leakage of stray current.

b. When an instrument or piece of equipment is properly grounded, leakage current returns to the earth, via the ______________________, causing no damage.

c. If the ground path is interrupted by ______________________________, leakage current will seek another path to ground, and this alternate path may be through O.R. personnel.

**OBJECTIVE 42**

Discuss at least five personnel safeguards and five environmental safeguards for preventing electrical and fire hazards in the operating room. Write your answers on the blank lines provided below.

a. Personnel safeguards ____________________

- ____________________
- ____________________
- ____________________
- ____________________
- ____________________

b. Environmental safeguards ____________________

- ____________________
- ____________________
- ____________________
- ____________________
- ____________________

**OBJECTIVE 43**

Match laser classes to their characteristics. Write the numbers on the blanks provided.

_______ a. Includes all intermediate power devices; maximum permitted power of lasers is 0.5 watt

_______ b. Includes all lasers that, under normal working conditions, cannot emit radiation that can cause damage; allowable maximum power of helium-neon laser is 0.4 microwatt

_______ c. Includes all visible lasers that emit radiation at a level that does not harm a person who has a normal iris reflex; maximum permitted power is 5 milliwatts for helium-neon and diode lasers in the visible wavelength

_______ d. High-power lasers that can cause damage to the eye even by diffusive reflectance, damage to the skin, and fire; includes any laser with power output of more than 0.5 watt

_______ e. Includes low-power visible light lasers that trigger the reflex of eye protection by the iris; allowable maximum power of continuous visible laser is 1 milliwatt

1. Class I
2. Class II
3. Class IIIa
4. Class IIIb
5. Class IV

**Objective 44**

Distinguish between specular and diffuse laser beam reflections. Place an "X" next to the description of diffusive reflectance.

_____ a. Light is reflected in one direction as from a mirror or other shiny surface.

_____ b. Light is scattered in all directions.

**Objective 45**

Match laser viewing hazards to their descriptions. Write the numbers on the blanks provided.

_______ a. Is most hazardous when the reflective surface is flat

_______ b. Is not normally hazardous, except with very high power lasers

_______ c. Is the most hazardous type of viewing

_______ d. Is less hazardous than a flat source reflection

1. Intrabeam viewing of direct beam
2. Intrabeam viewing of a specularly reflected beam from a flat surface reflector
3. Intrabeam viewing of a specularly reflected beam from a curved surface reflector
4. Extended source viewing of a normally diffuse reflection

**Objective 46**

Complete statements concerning laser beam hazards to the eyes and skin. Write your answers on the blank lines provided in the statements below.

a. The most likely effect of intercepting a laser beam with the eye is a __________________ which destroys the retinal tissue.

b. Since ________________ does not regenerate, the damage is permanent.

c. Laser pulses of a duration less than ________ microseconds induce a shock wave in the retinal tissue which causes tissue rupture.

d. ________________________________ is more destructive than a _______________________ because it usually affects a greater area of the retina, and the threshold energy for this effect is substantially lower.

e. ______________________________ occurs when the laser radiation wavelength is suited to excite reaction between organic molecules.

f. When UV or IR laser light enters the eye, much of the light is absorbed in the lens; depending on the level of exposure, this may cause immediate thermal burns or the development of ______________ over a period of years.

g. The __________________________ surrounding the eye can also be damaged by exposure to laser light.

h. Since amplification by the lens is not involved, the injuries can also be caused by ______________________________.

i. Skin can suffer ____________________ and photochemical changes from laser exposure.

**OBJECTIVE 47** Discuss at least two precautions for using lasers in the following areas. Write your answers on the blank lines provided below.

a. Patient safety precautions

- ________________________________________________
- ________________________________________________

b. Personal safety precautions

- ________________________________________________
- ________________________________________________

c. Environmental safety precautions

- ________________________________________________
- ________________________________________________

***Permission to duplicate this test is granted.**

## Answers to Written Test

**Objective 1**

a. Providing written policies and training for the safe use, handling, dispensing, and storing of hazardous materials
b. Following Center for Disease Control (CDC) guidelines on infection control
c. Providing protection from high noise levels
d. Providing adequate ventilation systems
e. Minimizing radiation exposure
f. Meeting standards for fire and electrical safety
g. Providing training in laser safety

**Objective 2**

a. 1971
b. U.S. Department of Labor
c. • death; serious injury
   • OSHA
d. • actions; conduct
e. injuries; illnesses
f. Material safety data sheets (MSDSs)
g. minimum
h. noncompliance

**Objective 3**

a. 25
b. hospitals
c. mentally ill
d. drugs
e. • Unrestricted
f. Low
g. Isolated
h. Solo
i. management

**Objective 4**

Answers may appear in any order.

a. Management commitment and employee involvement
b. Worksite analysis
c. Hazard prevention and control
d. Safety and health training

**Objective 5**

Answers should include any three of the following. Answers may appear in any order.

a. Demonstrated organizational concern for employees' emotional and physical safety and health.
b. Equal commitment to worker safety and health and patient/client safety.
c. Assigned responsibility for the various aspects of the workplace violence prevention program to ensure that all managers, supervisors, and employees understand their obligations.
d. Appropriate allocation of authority and resources to all responsible parties.
e. A system of accountability for involved managers, supervisors, and employees.
f. A comprehensive program of medical and psychological counseling and debriefing for employees experiencing or witnessing assaults and other violent incidents.
g. Commitment to support and implement appropriate recommendations from safety and health committees.

**OBJECTIVE 6**

Answers should include any two of the following. Answers may appear in any order.

a. Understanding and complying with the workplace violence prevention program and other safety and security measures
b. Participation in an employee complaint or suggestion procedure covering safety and security concerns
c. Prompt and accurate reporting of violent incidents
d. Participation on safety and health committees or teams that receive reports of violent incidents or security problems, make facility inspections, and respond with recommendations for corrective strategies
e. Taking part in a continuing education program that covers techniques to recognize escalating agitation, assaultive behavior, or criminal intent, and discusses appropriate responses

**OBJECTIVE 7**

a. construction
b. alarm
c. metal detectors
d. 24
e. curved mirrors
f. Enclose
g. safe
h. time-out
i. waiting
j. two
k. locked
l. entrapment
m. weapons
n. Lock

**OBJECTIVE 8**

a. violence
b. Report
c. assaults; threats
d. log books; reports
e. response
f. security officers
g. sign-in
h. restricted
i. policies; procedures
j. behavioral history
k. assaultive
l. jewelry
m. security escorts
n. buddy
o. policies; procedures
p. work plan
q. post-incident evaluation

**OBJECTIVE 9**

Answers should include any three of the following. Answers may appear in any order.

a. OSHA Log of Injury and Illness (OSHA 200)
b. Medical reports of work injury and supervisors' reports for each recorded assault
c. Incidents of abuse, verbal attacks or aggressive behavior—which may be threatening to the worker but do not result in injury, such as pushing or shouting and acts of aggression towards other clients—should be recorded, perhaps as part of an assaultive incident report.
d. Information on patients with a history of past violence, drug abuse, or criminal activity
e. Minutes of safety meetings, records of hazard analyses, and corrective actions recommended and taken
f. Records of all training programs, attendees, and qualifications of trainers

**OBJECTIVE 10**

b, c, e

**OBJECTIVE 11**

a, b, d, f, g

**OBJECTIVE 12**

a. mechanics
b. Walk
c. right
d. mirrors
e. slowly
f. • Push, pull
  • head
  • front
g. brakes
h. hold
i. back; pulling; after
j. recap

**OBJECTIVE 13**

a. 1
b. 7
c. 4
d. 6
e. 8
f. 3
g. 5
h. 2

**OBJECTIVE 14**

a. 2
b. 3
c. 1
d. 3
e. 1
f. 2
g. 3
h. 2

**OBJECTIVE 15**

Answers should include any three of the following. Answers may appear in any order.

a. Use nonlatex gloves for activities unlikely to involve contact with infectious materials.
b. If you choose latex gloves, use powder-free gloves with reduced protein content.
c. Report any hand rash for evaluation for possible latex allergy.
d. Use appropriate work practices to reduce the chance of reactions to latex.
  - When wearing latex gloves, do not use oil-based hand creams or lotions; these can cause glove deterioration.
  - Minimize skin contact time with potential allergens by removing gloves promptly when completing a procedure.
  - After removing latex gloves, wash hands with a mild soap and dry thoroughly.
  - Practice good housekeeping: frequently clean areas and equipment contaminated with latex-containing dust.
  - Change ventilation filters and vacuum bags frequently in areas identified as prone to latex dust.
  - Do not store latex gloves under conditions of excess heat or light, or near sources of ionizing radiation, since this will cause more rapid rubber deterioration.
  - Avoid touching your eyes, nose, or mouth while wearing latex or immediately upon removing a latex glove, in order to avoid potential latex sensitization via these routes.

e. Take advantage of all latex allergy education and training provided by your employer and become familiar with procedures for preventing latex allergy.
f. Learn to recognize the symptoms of latex allergy: skin rash, hives, flushing, itching, nasal, eye, or sinus symptoms, asthma, and (rarely) shock.

**OBJECTIVE 16**

a. disease
b. human immunodeficiency virus (HIV)
c. Any one of the following: contaminated blood, body fluids including semen, vaginal secretions, breast milk, and cerebrospinal fluid, and tissue cultures
d. infected
e. skin; mucous membrane; skin

**OBJECTIVE 17**

a, e, f, h, i, j

**OBJECTIVE 18**

a, c, d, g, h, j

**OBJECTIVE 19**

a. Perinatal
b. Perinatal
c. 5–6
d. 40–180
e. 10
f. One-third
g. jaundice
h. Death
i. Death

**OBJECTIVE 20**

Answers should include any seven of the following. Answers may appear in any order.

a. Wire sutures
b. Hollow injection needles
c. Guide wires
d. Stylets
e. Drain trocars
f. Laparoscopic trocars
g. Orthopedic drill bits, screws, pins, wires, and saws
h. Urethral suspension needles
i. Needle point cautery tips
j. Microscissors and other sharp pointed scissors
k. Sharp pointed retractors
l. Skin hooks
m. Penetrating towel clips
n. Tenaculi
o. Thyroid clamps
p. Broken glass instruments and vials
q. Syringes

**OBJECTIVE 21**

Answers should include any five of the following. Answers may appear in any order.

a. Assembling and disassembling scalpel
b. Mounting needle in needle holder
c. Repositioning needle in needle holder
d. Passing needle or scalpel hand to hand between team members
e. Suturing and cutting
    - Using fingers as a backstop or to guide needle during suturing
    - Holding tissue with the hand during suturing
    - Cutting toward fingers of surgeon or assistant
    - Protecting structures adjacent to surgeon's suturing with hand
f. Retracting wound tissue manually
g. Tying while needle is attached
h. Leaving needle on field while tying
i. Holding needle in hand or needle holder while tying

j. Before and after using on the field
  - Needle or scalpel left on field contacts worker's hand
  - Dropping needle or scalpel on worker's foot
  - Reaching for device sliding off drapes

k. Placing needle or scalpel in poorly designed, overfilled, or improperly positioned disposal container or in container with too small an opening

**OBJECTIVE 22**

a. Neutral or Safe
b. fingers
c. push/pull
d. disposing
e. arm's reach
f. behind
g. unobstructed
h. overfilling
i. Never

**OBJECTIVE 23**

a. 2
b. 3
c. 1

**OBJECTIVE 24**

a. lock
b. mid-curve
c. Grasp
d. manual
e. percutaneous
f. minimally
g. thin
h. blunt; sharp

**OBJECTIVE 25**

a. Basic guidelines for infection control published in 1988 by the Centers for Disease Control and Prevention (CDC); if followed, the guidelines protect healthcare workers against contact with blood and body fluids that transmit bloodborne pathogens

b. New set of guidelines for infection control released by the Centers for Disease Control and Prevention (CDC) in 1994; guidelines are expanded to include gloves for all contact with feces, urine, nasal secretions, vomitus, and sputum to decrease the transmission of viruses found in these substances

**OBJECTIVE 26**

a. latex; vinyl
b.
  - phlebotomy
  - finger; heel
  - mucous membranes
  - IV lines

c. patient
d. wash; clean
e.
  - substances; moist

f. mask; face shield
g. apron; gown
h.
  - sharps containers
  - drains; sewer

i. specimens
j.
  - bags

k. policies
l. soil
m. germicide
n. mouthpieces
o. lesion; lesion

**OBJECTIVE 27**

Answers should include any eight of the following. Answers may appear in any order.

a. Blood
b. Sputum
c. Urine
d. Feces
e. Nasal secretions
f. Vomitus
g. Spinal fluid
h. Semen
i. Cerebrospinal fluid
j. Synovial fluid
k. Pleural fluid
l. Peritoneal fluid
m. Pericardial fluid
n. Amniotic fluid
o. Nonintact skin
p. Mucous membranes

**OBJECTIVE 28**

Answers should include any four of the following. Answers may appear in any order.

a. At the beginning of every work shift
b. Before and after prolonged contact with patient
c. Before invasive procedures
d. Before contact with especially susceptible patients
e. Before and after touching wounds
f. After contact with body substances, even when gloves are worn
g. Any time you are in doubt about the necessity for doing so
h. At the end of every shift before leaving the health care facility

**OBJECTIVE 29**

Answers should include any five of the following. Answers may appear in any order.

a. For medical and aseptic purposes, perform at least a vigorous 10-second hand washing that includes "rubbing together all surfaces of lathered hands followed by rinsing in a stream of water."
b. For medical and aseptic purposes when the hands are visibly soiled, take more than 10-seconds to perform hand washing procedure.
c. Use friction, running water, and a cleansing agent when washing hands.
d. Plain liquid or powdered soap as a cleansing agent is adequate in all situations but those requiring antimicrobial products.
e. If bar soap is the only type available, lather and rinse the bar thoroughly to remove the outside layer of soap before you use it.
f. Use antimicrobial products as cleansing agents when washing hands in the following situations:
    - Newborn care
    - Between patients in high-risk unit
    - Before the care of immunosuppressed patients

g. When possible use a deep sink operated by foot, leg, or elbow controls.
h. Where faucets are operated by hand, use a dry paper towel to turn off the water because a dirty hand was used to turn it on.
i. Because hand washing procedure causes microorganisms to accumulate in the sink, avoid touching the sink as you wash and avoid splashing dirty water on your uniform.
j. It is not necessary to clean your nails each time you wash your hands; clean under your finger nails before you leave home if a nail file or orangewood stick is not available at the hand washing site.

**OBJECTIVE 30**

b, c, e

**OBJECTIVE 31**

a. cancer
b. ionizing
c. amount; duration
d. years
e. Overexposure
f. purple; black; yellow

**OBJECTIVE 32**

a. 2
b. 3
c. 1

**OBJECTIVE 33**

a. Patient safety—Answers should include the following in student's own words.
   - Shield body areas from scatter radiation.
   - Take an x-ray for a lost sponge or needle only after a thorough search has been made.
   - Turn off the fluoroscope and other equipment when not in use.
   - Use lead shields to protect the reproductive organs of all women, whether or not they are pregnant.
   - At least annually test all shielding devices such as lead aprons, thyroid shields, and gloves used for radiation protection during x-ray procedures.

b. Personnel safety—Answers should include the following in student's own words.
   - When possible, rotate assignments on procedures that involve radiation.
   - Turn off machines when not in use.
   - Leave radioactive elements in lead-lined containers until ready to use.
   - Use protective shields and equipment when necessary.
   - Use a monitoring device to measure accumulated exposure to radiation.

**OBJECTIVE 34**

Answers should include any three of the following. Answers may appear in any order.

a. Radioactive contamination outside a licensed area
b. Deliberate misuse of radioactive materials
c. Known or suspected personnel contamination, inhalation, injection, or ingestion of radioactive material
d. Any accident resulting in direct exposure to personnel
e. Known or suspected loss of radioactive material, including loss to the air or sewer
f. Contaminated or damaged radioactive material shipments

**OBJECTIVE 35**

a. 2
b. 5
c. 6
d. 4
e. 1
f. 7
g. 3

**OBJECTIVE 36**

Answers may appear in any order.

a. Cyclopropane
b. Divinyl ether
c. Ethyl ether
d. Ethyl chloride
e. Ethylene

**OBJECTIVE 37**

a, c, d

**OBJECTIVE 38**

a. 1
b. 3
c. 2
d. 4

**OBJECTIVE 39**

Answers should include any two of the following. Answers may appear in any order.

a. Malfunctioning, heat-generating devices in contact with patient
b. Pooling of prep solution under the patient when using electrocautery
c. Using alcohol sponges when using electrocautery
d. Using phenol as a marking agent or a prep solution
e. Using hyperthermia unit with mattress above 140°F
f. Physical fire

**OBJECTIVE 40**

c, d, e, f, g

**OBJECTIVE 41**

a. Any one of the following: heart monitors, defibrillators, x-ray machines, electrosurgical units, and electrical saws and drills
b. ground
c. Any of the following: broken or frayed cords, plugs, or defective equipment

**OBJECTIVE 42**

Answers should include any five of the following. Answers may appear in any order.

a. Personnel safeguards
   - Wear proper operating room attire and conductive shoe covers.
   - Cover all hair to prevent electrostatic sparks.
   - Never use open flames in the operating room.
   - Never move a patient from one area to another while a flammable anesthetic is being administered.
   - Properly ground a patient before using an electrosurgical unit.
   - Always check electrical cords and wires for fraying and breakage before using.
   - Never use a piece of electrical equipment without having been taught the proper procedure for using it.
   - Properly ground a patient before using an electrosurgical unit.
   - Always check electrical cords and wires for fraying and breakage before using.
   - Never use a piece of electrical equipment without having been taught the proper procedure for using it.
   - If equipment appears damaged or malfunctioning, immediately discontinue its use, red tag it, and send it for repair.
   - Avoid unnecessary motion around the patient's head and the anesthesia machine.
   - Turn off all electrical equipment as soon as it is no longer needed.

b. Environmental safeguards
   - Use air conditioning with controlled humidity in all operating rooms to reduce explosion hazards, provide comfort for the patient and personnel, and help control airborne bacteria.
   - Keep the O.R. temperature range between 60°F–80°F with the average about 70°F.
   - Keep the O.R. humidity between 55%–60% to minimize static electricity build-up in the presence of flammable anesthetic agents.
   - Ensure that air-conditioning units function properly and that air intakes and exhausts have been installed in the proper places to provide proper ventilation and filtration.
   - Ensure that positive static pressure is used in the O.R.
   - Keep the O.R. room doors closed in order to maintain a positive static pressure.
   - Make sure that the operating room furniture is made of metal or conductive rubber.
   - Use only cotton blankets or sheets in the O.R. because wool, silk, nylon, and synthetic materials have high static potential.

- Ensure that all electrical receptacles (outlets and switches) are at least 5 feet above the floor or explosion-proof.
- Keep anesthesia machines, cylinders of compressed gas, and flammable liquid containers away from heat and do not allow them to touch each other.
- Anchor compressed gas cylinders with a chain or place in a secure rack to prevent mishaps.

**OBJECTIVE 43**

a. 4
b. 1
c. 3
d. 5
e. 2

**OBJECTIVE 44**

b

**OBJECTIVE 45**

a. 2
b. 4
c. 1
d. 3

**OBJECTIVE 46**

a. thermal burn
b. retinal tissue
c. 10
d. Thermal-acoustic damage; thermal burn
e. Photochemical damage
f. cataracts
g. cornea and the conjunctiva tissue
h. diffuse and noncoherent light
i. thermal burns

**OBJECTIVE 47**

a. Patient safety precautions—Answers should include any two of the following. Answers may appear in any order.
  - Use noncombustible anesthetic agents.
  - Properly protect endotracheal tubes by insulating or wrapping with reflective aluminum or copper tape.
  - Protect the patient's eyes.
  - Use nonflammable antiseptic for skin preparation.
  - Protect skin surrounding an incision and/or target tissue from possible thermal burn.
  - Include in the postoperative instructions to the patient the care of a healing thermal wound on the skin.

b. Personal safety precautions—Answers should include any two of the following. Answers may appear in any order.
  - Wear proper eye protection.
  - Do not wear rings, watches, or other metallic apparel.
  - Protect your skin.
  - Avoid inhaling the laser plume.

c. Environmental safety precautions—Answers should include any two of the following. Answers may appear in any order.
  - Post warning signs on all doors.
  - Ensure that walls and ceilings have nonreflective surfaces.
  - Ensure that warning labels indicate points of danger to avoid exposure to laser radiation.
  - Check machine for proper functioning; red tag, remove from service, and send for repair if damaged or malfunctioning.
  - Place the machine on "standby" setting when not in use during the surgical procedure.

- Monitor the laser foot switch.
- Use nonreflective instruments.
- Keep on hand a basin of sterile water in case of fire.
- Ensure that all electrical codes are followed and enforced.
- Follow the manufacturer's instructions and cautions for operation, care, handling, and sterilization procedures

## Module Review

Name ______________________________________________

Date ________________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 23

1. Which blunt needles work well for most applications with the exception of bowel anastomosis?
   a. least blunt
   b. intermediate blunt
   c. double blunt
   d. extremely blunt

Objective 3

2. All of the following are OSHA risk factors for violence to health care workers except ____________________.
   a. increased use of hospitals by police for criminal holds for the acutely disturbed, violent individuals
   b. the availability of drugs or money at health care facilities
   c. high staffing levels during meal and visiting times
   d. solo work, often in remote locations

Objective 40

3. Which of the following statements concerning static electricity is true?
   a. Static electricity is an uncommon hazard in the operating room.
   b. Static electricity can cause patient shock or burns.
   c. Static electricity produces a spark which can ignite materials in the operating room.
   d. A conductive operating room floor does not prevent accumulation of static electricity.

Objective 43

4. Which of the following would be a Class IV laser?

   a. CD player

   b. laser pointer

   c. spectrometry laser

   d. surgical laser

Objective 6

5. Which of the following is NOT a responsibility of employees in creating an effective workplace violence prevention program?

   a. taking part in judo, karate, and other self-defense classes

   b. participating on safety and health committees and teams

   c. prompt and accurate reporting of all violent incidents

   d. participating in employee complaint procedures

Objective 28

6. Standard Precautions recommend washing hands in each of the following situations EXCEPT ______________________.

   a. immediately after contact with body substances or moist body surfaces

   b. between patients

   c. before removing gloves

   d. immediately after removing gloves

Objective 42

7. Which of the following is NOT an environmental safeguard for preventing electrical fires in the operating room?

   a. keep operating room humidity between 55% and 60%

   b. keep operating room at an average temperature of about 75°F

   c. keep operating room doors closed to maintain static pressure

   d. use only cotton blankets or sheets

Objective 18

8. What bloodborne pathogen is acquired by sharps injuries in more than 80% of occupational acquired cases?

   a. HCV

   b. HIV

   c. HBV

   d. HDV

Objective 12

9. What is the proper way to turn corners in a health care facility?
   a. slowly, checking ceiling mirrors on intersecting walls
   b. carefully, at least 5 feet left of right wall and checking mirrors
   c. slowly, at least 5 feet from left wall and checking mirrors
   d. cautiously, checking around corner for oncoming personnel/equipment before turning

Objective 13

10. For what procedure are "space suits" most commonly worn?
    a. pediatric
    b. orthopedic
    c. ophthalmic
    d. abdominal

Objective 17

11. Which type of hepatitis is transmitted primarily through contact with feces of an infected person?
    a. HDV
    b. HCV
    c. HBV
    d. HAV

Objective 14

12. What causes latex allergy?
    a. carbohydrate powders in processed latex
    b. reaction of sweat with the IgE in latex
    c. proteins in latex rubber
    d. mechanical abrasive effect of glove powder

Objective 28

13. All of the following instances require hands to be washed EXCEPT ____________.
    a. before leaving home for work
    b. at the beginning of each work shift
    c. before and after prolonged contact with a patient
    d. any time there is doubt about the necessity for doing so

Objective 1

14. Which of the following is NOT an OSHA regulation required of employers?

    a. following CDC guidelines on infection control

    b. providing protection from high noise levels

    c. providing training for fighting facility fires

    d. providing training for laser safety

Objective 47

15. What of the following is a true statement concerning safety precautions for using lasers?

    a. Laser plumes are harmless vaporization of tissue.

    b. Endotracheal tubes can be protected by wrapping them with surgical tape.

    c. A gold wedding band can reflect the light of a laser.

    d. Eye protection does not need to be worn with Class IV lasers.

Objective 38

16. What type of burn is caused by contact with hot objects?

    a. thermal

    b. electrical

    c. chemical

    d. radiation

Objective 12

17. When should contaminated needles be manually recapped?

    a. immediately after use

    b. before discarding them

    c. before setting them down

    d. never

Objective 1

18. OSHA requires employers to develop a written Haz Com program to include education/training in all of the following areas EXCEPT ________________.

    a. warning labels on containers

    b. material safety data sheets

    c. portable extinguisher use

    d. proper handling, use, storage, and transportation of chemicals

Objective 13

19. What is the MAIN purpose of headwear as personal protective equipment?
    a. preventing hair and scalp debris from contaminating patient
    b. repelling blood and body fluids
    c. keeping head warm in air conditioned operating room
    d. keeping hair off face and out of eyes

Objective 7

20. Which of the following is NOT a work practice that can be followed to help prevent workplace violence?
    a. limiting coffee urns, magazines, and television access in interview rooms and visitor waiting areas
    b. replacing or repairing burned out light bulbs, broken windows and locks
    c. using closed-circuit video recording on a 24-hour basis
    d. providing employee "safe rooms" or "safe floors" for use during emergencies

Objective 11

21. What level of hazard does a CAUTION label on a chemical container indicate?
    a. lethal
    b. least severe
    c. very severe
    d. most severe

Objective 13

22. For what procedures are trauma boots appropriate personal protective equipment for protection from bloodborne pathogens?
    a. abdominal
    b. ophthalmic
    c. orthopedic
    d. obstetrical

Objective 2

23. Which of the following is a role of OSHA in workplace health and safety?
    a. setting maximum standards and requirements for employers and employees
    b. providing employers with MSDS on each hazardous substance used by employees
    c. policing facilities for OSHA violations and levying penalties for noncompliance
    d. providing the CDC with records of employee occupational injuries and illnesses

Objective 15

24. Which of the following is NOT a reason for choosing powder-free, hypoallergenic gloves?

    a. to prevent latex allergen from transferring from the latex to the powder

    b. to prevent allergen coated particles from becoming airborne and contaminating large areas

    c. to minimize skin contact time with potential latex allergen

    d. to prevent latex allergy

Objective 16

25. Bloodborne pathogens are found in all of the following EXCEPT ________________.

    a. breast milk

    b. tissue cultures

    c. cartilage

    d. semen and vaginal secretions

Objective 17

26. What organ is the primary target of the hepatitis viruses?

    a. spleen

    b. liver

    c. kidneys

    d. lungs

Objective 22

27. Which of the following statements concerning safely handling sharps and sharps boxes is true?

    a. If it is necessary to remove a sharp from a sharps box, always use an instrument.

    b. Use your fingers only to recap those needles that must be reused during a procedure for incremental injection.

    c. Avoid unnecessary assisting by keeping hands away from the incision during cutting and suturing.

    d. Protect other personnel by leaning over the incision when suturing or cutting is taking place.

Objective 24

28. Which of the following statements concerning safe blunt needle suturing techniques is FALSE?

    a. Grasp and stabilize the tissue to be sutured to facilitate penetration.

    b. Mount needle three-quarters of the way back in the needle holder.

    c. Avoid using thin-gauge needles with dense tissue.

    d. Use a strong needle holder and fully activate the lock.

Objective 2

29. When did OSHA's workplace safety regulations become federal law?

    a. 1971

    b. 1987

    c. 1932

    d. 1958

Objective 4

30. Which of the following is NOT one of the four main components of an effective workplace violence prevention program?

    a. worksite analysis

    b. management commitment and employee involvement

    c. hazard prevention and control

    d. self-defense training

Objective 23

31. What blunt needle category does not penetrate tissue such as fascia easily and should not be used for that purpose?

    a. sharp needle

    b. least blunt needle

    c. intermediate blunt needle

    d. extremely blunt needle

Objective 27

32. Which of the following is NOT a substance that requires gloves as listed in Standard Precautions?

    a. intact skin

    b. amniotic fluid

    c. mucous membranes

    d. synovial fluid

Objective 5

33. Which of the following is NOT a responsibility of management in creating an effective workplace violence prevention program?

   a. organizational concern for employee safety
   b. equal commitment to worker safety and community safety
   c. an accountability system for involved managers, supervisors, and employees
   d. a comprehensive employee counseling program

Objective 18

34. What bloodborne pathogen is harbored by up to 18% of emergency room patients?

   a. HCV
   b. HIV
   c. HBV
   d. HDV

Objective 20

35. Which of the following devices is NOT usually responsible for a sharps injury?

   a. tenaculi
   b. synthetic sutures
   c. stylets
   d. cautery tips

Objective 26

36. Which of the following is NOT a way that the Standard Precautions recommends that soiled linens be handled?

   a. Hold all soiled linen away from your uniform.
   b. Gently shake any linens not contaminated with body fluids.
   c. Do not shake or toss soiled linens.
   d. Place all contaminated linen in leakage-resistant bags before transport.

Objective 31

37. Which of the following is a delayed effect caused by repeated or prolonged radiation exposure?

   a. anorexia
   b. tissue necrosis
   c. leukemia
   d. genetic changes

Objective 39

38. Which of the following is NOT a health-care related cause of patient thermal burns?
    a. pooling of prep solution under the patient when using electrocautery
    b. using hyperthermia unit with mattress below 140°F
    c. using alcohol sponges when using electrocautery
    d. using phenol as a marking agent or a prep solution

Objective 47

39. Which of the following environmental safety precautions for laser use is FALSE?
    a. Keep a basin of sterile water on hand in case of fire.
    b. Post warning signs on all doors.
    c. Use nonreflective instruments.
    d. Ensure that walls and ceilings have reflective surfaces.

Objective 31

40. Which of the following is a serious effect caused by massive radiation exposure?
    a. disturbances in blood cell formation
    b. carcinogenesis
    c. bone marrow injury
    d. anorexia

Objective 8

41. Which of the following is NOT a work practice to help prevent workplace violence?
    a. reporting all incidents of violence
    b. providing the public with physical layouts of the facility
    c. keeping logbooks and reports of all assaults or threats
    d. providing sensitive and timely information to persons waiting for service

Objective 11

42. What level of hazard does a DANGER label on a chemical container indicate?
    a. lethal
    b. least severe
    c. very severe
    d. most severe

Objective 30

43. Which of the following guidelines for personal hygiene in the health care workplace is FALSE?

    a. Keep hair short or restrain it so that it cannot fall forward.

    b. Keep fingernails clean and trimmed or filed short.

    c. Do not wear fingernail polish of any shade.

    d. Do not wear necklaces or hoop earrings.

Objective 38

44. Sunburn is an example of what type of burn?

    a. thermal

    b. electrical

    c. chemical

    d. radiation

Objective 40

45. Which of the following substances may be used to clean an operating room floor?

    a. common floor wax

    b. ordinary detergent

    c. iodophor

    d. linseed oil

Objective 9

46. Which of the following records is important to the success of a workplace violence prevention program?

    a. employee identification cards

    b. OSHA log of punitive steps taken in past

    c. search warrants and power of attorney

    d. medical reports of work injury and assaults

Objective 11

47. Which of the following should NOT be included on a chemical label?

    a. potability

    b. toxicity

    c. reactivity

    d. radioactivity

Objective 19

48. What is the primary transmission method for HBV?

    a. sexual contact

    b. parenteral

    c. perinatal

    d. inhalation

Objective 25

49. *To provide basic guidelines to protect health care workers against contact with blood and body fluids that transmit bloodborne pathogens* was the purpose of what document published by the CDC in 1988?

    a. Standard Precautions

    b. Universal Precautions

    c. Global Precautions

    d. Basic Precautions

Objective 26

50. Which statement below is NOT recommended as a Standard Precaution?

    a. Change gloves between patient contacts.

    b. Wear a disposable moisture-proof apron or gown during procedures likely to generate splatters.

    c. Place all specimens in moisture-proof containers.

    d. Wash or clean examination gloves before removal and disposal.

Objective 12

51. Which of the following is the proper way to maneuver a wheelchair into an elevator that has been placed on HOLD?

    a. Push the wheelchair in, and then turn it to face the doors.

    b. Push the wheelchair in, and then back it out at the desired floor.

    c. Push the wheelchair in, and then turn it sideways to avoid bumping the patient's feet.

    d. Back into the elevator, pulling the wheelchair in after you.

Objective 41

52. Which of the following is NOT a reason for grounding all electrical equipment in the operating room?

    a. to prevent leakage current

    b. to allow stray leakage current to return harmlessly to earth

    c. to channel stray leakage current through the grounded operating room floor

    d. to prevent stray leakage current from grounding through a patient or other surgery personnel

Objective 43

53. Which of the following would be a Class IIIb laser?

a. CD player

b. laser pointer

c. spectrometry laser

d. surgical laser

Objective 45

54. Which of the viewing methods illustrated below is most hazardous to the human eye?

a. intrabeam viewing of a specularly reflected (secondary) beam from a flat surface reflector

b. intrabeam viewing of a specularly reflected (secondary) beam from a curved surface reflector

c. intrabeam viewing of direct (primary) beam

d. extended source viewing of a normally diffuse reflection

Objective 29

55. Which of the following CDC guidelines for medical and aseptic hand washing is FALSE?

a. Perform a vigorous 60-second hand washing.

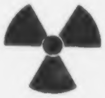
b. Use friction, running water, and a cleansing agent.

c. When possible, use a sink operated by foot, leg, or elbow controls.

d. Where faucets are operated by hand, use a dry paper towel to turn off the water.

Objective 31

56. What is the following symbol used to identify?



a. radioactive materials

b. fallout shelter

c. oscillating fan

d. airplane propeller

Objective 12

57. How should a stretcher be moved?

    a. with the brake partially engaged
    b. with the patient's head away from your body
    c. pushed
    d. pulled

Objective 14

58. Which of the following reactions to latex is a systemic allergic reaction?

    a. irritant dermatitis
    b. delayed cutaneous hypersensitivity (Type IV allergy)
    c. immediate reaction (Type I allergy)
    d. contact dermatitis

Objective 18

59. Which of the following is a mutating virus for which researchers have been unable to find a cure or vaccine?

    a. HAV
    b. HBV
    c. HCV
    d. HDV

Objective 21

60. Which of the following is NOT a common cause of needle or scalpel sharps injury?

    a. holding needle in hand while tying
    b. suturing and cutting using fingers as a backstop
    c. assembling and disassembling scalpel
    d. tying while needle is unattached

Objective 26

61. Standard Precautions recommend gloves for all of the following situations except ____________________.

    a. handling urine or feces
    b. performing finger or heel sticks in infants and children
    c. performing phlebotomy
    d. taking blood pressure

Objective 32

62. What type of ionizing radiation are x-rays?

a. alpha

b. beta

c. gamma

d. sigma

Objective 35

63. What is the traditional U.S. color for nitrous oxide cylinders?

a. red

b. blue

c. yellow

d. green

Objective 37

64. Which of the following statements is true?

a. The temperature at the end of a high-intensity fiber optic cord is well below the ignition temperature of most surgical drapes or gowns.

b. Accidental activation of a laser beam has resulted in airway fires from the ignition of the endotracheal tube.

c. The temperature at the tip of an electrode used in electrosurgery can cauterize tissue but cannot ignite drapes, gowns, or anything else it contacts.

d. Most hospitals and health care facilities continue to use flammable anesthetics but do so with increased caution.

Objective 13

65. When is neckwear an appropriate addition to standard operating room personal protective equipment?

a. when patient is a known carrier of bloodborne pathogen

b. when operating room temperatures must be lowered below 60°F

c. when wearing a collarless surgical gown

d. when the surgical technologist has a cold

Objective 13

66. For what type of procedures are fluid resistant gowns selected as appropriate personal protective equipment?

a. those that have low risk for exposure to bloodborne pathogens

b. those in which massive blood or fluid contamination is expected

c. those associated with significant blood loss and prolonged duration

d. those in which power tools present a special splatter hazard

Objective 18

67. What virus permits opportunistic infections, malignancies, and neurologic diseases such as Karposi's sarcoma, lymphoma of the brain, and certain types of pneumonia?

a. HBV
b. HCV
c. HEV
d. HIV

Objective 26

68. What may be used in place of a commercial germicidal solution for cleaning visible soil from objects before disinfecting?

a. mild soap and water
b. household bleach in a 1:10 dilution
c. hydrogen peroxide
d. detergent and water

Objective 32

69. In which type of ionizing radiation can the radiation particles be prevented from penetration by a piece of paper or by human skin?

a. alpha
b. beta
c. gamma
d. sigma

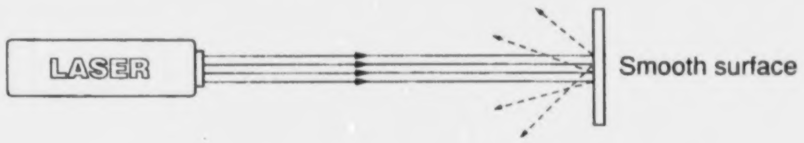
Objective 34

70. Which of the following conditions requires immediate notification of the health care facility radiation safety officer?

a. radioactive contamination inside a licensed area
b. receipt of all radioactive shipments
c. any situation in which radioactive material will be used
d. any accident resulting in direct exposure to personnel

Objective 44

71. What type of laser beam reflection does the picture below illustrate?



   a. specular reflectance
   b. diffusive reflectance
   c. secular reflectance
   d. disuse reflectance

Objective 46

72. What causes thermal-acoustic damage to the eye?

   a. laser pulses of duration less than 10 microseconds
   b. radiation wavelength that excites reaction between organic molecules
   c. UV or IR light entering the eye
   d. intercepting a laser beam with the eye

Objective 32

73. Which type of ionizing radiation is most penetrating?

   a. alpha
   b. beta
   c. gamma
   d. sigma

Objective 17

74. What does the term *endemic* mean?

   a. characteristic of or prevalent in a particular or environment
   b. affecting a large number of individuals within a population
   c. an endothermic biological reaction
   d. occurring over a very wide geographic area

Objective 16

75. Bloodborne pathogens can enter another person's bloodstream through all the following routes except ______________.

    a. unprotected opening in the skin
    b. unprotected mucous membrane opening
    c. penetration of the skin by a sharp object
    d. absorption through unbroken skin

Objective 15

76. Which of the following is NOT an appropriate work practice to reduce the chance of reactions to latex?

    a. not using oil-based hand creams
    b. changing ventilation filters and vacuum bags frequently
    c. removing gloves promptly after completing a procedure
    d. washing hands with mild soap and water before removing gloves

Objective 13

77. What area of the body is most vulnerable to serious blood exposures?

    a. hands
    b. feet
    c. nose
    d. eyes

Objective 14

78. What type of reaction to latex is described as "a skin irritation that does not involve the body's immune response"?

    a. irritant dermatitis
    b. delayed cutaneous hypersensitivity (Type IV allergy)
    c. immediate reaction (Type I allergy)
    d. contact dermatitis

Objective 17

79. Which type of hepatitis is a defective virus that needs the hepatitis B virus to exist?

    a. HBV
    b. HEV
    c. HDV
    d. HCV

Objective 19

80. What is the prognosis for the patient infected with HIV?

a. complete recovery

b. chronic carrier

c. death

d. complications such as cirrhosis

Objective 16

81. Which of the following is NOT one of the most common bloodborne pathogens that concern operating room personnel?

a. HBV

b. HEV

c. HIV

d. HCV

Objective 35

82. What is the traditional U.S. color for oxygen cylinders?

a. red

b. blue

c. yellow

d. green

Objective 35

83. What is the traditional U.S. color for air cylinders?

a. red

b. blue

c. yellow

d. green

Objective 43

84. Which of the following would be a Class I laser?

a. CD player

b. laser pointer

c. spectrometry laser

d. surgical laser

Objective 42

85. Which of the following statements concerning personnel safeguards for preventing electrical fires in the operating room is FALSE?

a. Cover all hair to prevent electrostatic sparks.

b. Never use open flames in the operating room.

c. Wear nonconductive shoe covers.

d. Never move a patient from one area to another while flammable anesthetic is being administered.

Objective 36

86. Which of the following anesthetic gases is NOT flammable?

a. divinyl ether

b. cyclopropane

c. halothane

d. ethyl chloride

Objective 46

87. Which of the following statements is true?

a. UV or IR laser light wavelengths are capable of penetrating the retina.

b. The cornea and conjunctiva tissue surrounding the eye cannot be damaged by exposure to laser light.

c. Prolonged exposure to low-level laser radiation causes irreversible changes in biological tissue.

d. The skin can suffer thermal-acoustic damage from laser light.

Objective 33

88. Which of the following is NOT a personnel radiation safety practice?

a. Use a monitoring device to measure accumulated exposure to radiation.

b. Remove radioactive elements from lead-lined box no more than one hour before use.

c. When possible, rotate assignments on procedures that involve radiation.

d. Turn off x-ray machines when not in use.

Objective 32

89. What type of ionizing radiation requires a shield at least as thick as a concrete wall to protect yourself from its rays?

a. alpha

b. beta

c. gamma

d. sigma

Objective 35

90. What is the traditional U.S. color for helium cylinders?

    a. blue
    b. black
    c. brown
    d. gray

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. a
2. c
3. c
4. d
5. a
6. c
7. b
8. b
9. a
10. b
11. d
12. c
13. a
14. c
15. c
16. a
17. d
18. c
19. b
20. a
21. b
22. d
23. c
24. d
25. c
26. b
27. c
28. b
29. a
30. d
31. d
32. a
33. b
34. a
35. b
36. b
37. c
38. b
39. d
40. c
41. b
42. d
43. c
44. d
45. c
46. d
47. a
48. b
49. b
50. d
51. d
52. c
53. c
54. c
55. a
56. a
57. c
58. c
59. c
60. d
61. d
62. c
63. b
64. b
65. a
66. a
67. d
68. b
69. a
70. d
71. b
72. a
73. c
74. a
75. d
76. d
77. d
78. a
79. c
80. c
81. b
82. d
83. c
84. a
85. c
86. c
87. c
88. b
89. c
90. c

# Introduction to Surgical Technology

## SECTION C:
## Microbiology

### Module 1-C: Introduction to Microbiology

## Module Contents

**COMPONENTS**

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module" and "Suggested Web Sites" for more information.
- Make copies of any teacher supplements that will be provided for each student.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheet. Review with students the criteria for evaluation of this activity.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheet. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheet for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to introduce students to microbiology as it relates to surgical technology.

- Either have a guest speaker talk to the class or arrange a field trip to a local medical laboratory or pathology department so students will have a better understanding of the work of microbiologists, bacteriologists, and medical lab technicians.
    - Have these resource people demonstrate activities they use to study microorganisms, such as preparing slides, Gram staining, and culturing. Also have them discuss safety precautions they must follow when working with microorganisms.
    - Have them demonstrate the proper use of a microscope, and then have students examine prepared Gram-negative and Gram-positive slides.
- Discuss the relationship between microbiology and aseptic technique used in surgery and other areas of health care.
- Discuss the types of pathogens that can cause nosocomial infections. Refer to Teacher Supplement 1 for a partial listing.
- Use the student supplements included with this module to reinforce this basic information and terminology. These can be used by groups or individuals. You can also use them with the entire class or teams as a review game.
- You may wish to assign the research topics in Assignment Sheet 1 so that all are covered, or so that the more common diseases are examined. Let students know whether you want written or oral reports. After the reports are completed, have students discuss which diseases are of the most concern.

**RESOURCES USED IN DEVELOPING THIS MODULE**

- Burton, Gwendolyn R. W. *Microbiology for the Health Sciences.* 6th ed. Philadelphia: Lippincott Williams & Wilkins Publishers, 1999.
- *Core Curriculum for Surgical Technology.* 5th ed. Centennial, CO: Association of Surgical Technologists, 2002.
- Fortunato, Nancymarie. *Berry and Kohn's Operating Room Technique.* 9th ed. St. Louis: Mosby, Inc., 2000.

- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery*. 11th ed. St. Louis: Mosby, Inc., 1999.
- Tamparo, Carol, and Marcia A. Lewis. *Diseases of the Human Body*. 3rd ed. Philadelphia: F.A. Davis, 2000.

**SUGGESTED WEB SITES***

✔ **NOTE:** The following Web sites offer information concerning microbiology.

- http://jcm.asm.org/

  The Web site for the Journal of Clinical Microbiology contains articles on bacteriology, mycology, virology, as well as other topics of interest.

- http://jvi.asm.org/

  The Web site for the Journal of Virology contains articles related to the structure and assembly, replication, and recombination of viruses.

- http://www.journals.asm.org/

  This Web site contains links to 11 journals that cover the spectrum of microbiology, from molecular and cellular biology to biomedical research and technology on drugs, as well as information on the research of medication, prevention, treatment, and policy.

- http://www.suite101.com/welcome.cfm/microbiology

  Suite 101's Web site contains an abundance of medical microbiology information, including links to articles and other Web sites related to microbiology.

- http://www.cellsalive.com

  This Web site contains interactive views of plant cells, animal cells, mitosis, cell cycle, as well as information on cell biology, microbiology, immunology, and microscopy.

- http://www.bact.wisc.edu/MicrotextBook/

  Microbiology Webbed Out contains a multitude of information concerning bacteria.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

## Teacher Supplement 1—Pathogens That May Cause Nosocomial Infections

| Organisms | Aerobic | Gram Stain | Morphology |
|---|---|---|---|
| *Staphylococcus aureus* | yes | + | cocci |
| *Streptococcus* group B & D | yes | + | cocci |
| *Streptococcus aureus* (methicillin-resistant) | yes | + | cocci |
| *Neisseria gonorrhoeae* | yes | — | cocci |
| *Mycobacterium* | yes | — | bacilli |
| *Escherichia coli* | yes | — | bacilli |
| *Pseudomonas aeruginosa* | yes | — | bacilli |
| *Hemophilus influenzae* | yes | — | bacilli |
| Hemolytic and non-hemolytic *streptococci* | microaerophilic | + | cocci |
| *Peptostreptococcus* | anaerobic | + | cocci |
| *Clostridium tetani* | anaerobic | + | bacilli |
| *Bacteroides fragilis* | anaerobic | — | bacilli |

Note: This list is by no means a complete list of pathogens responsible for nosocomial infections.

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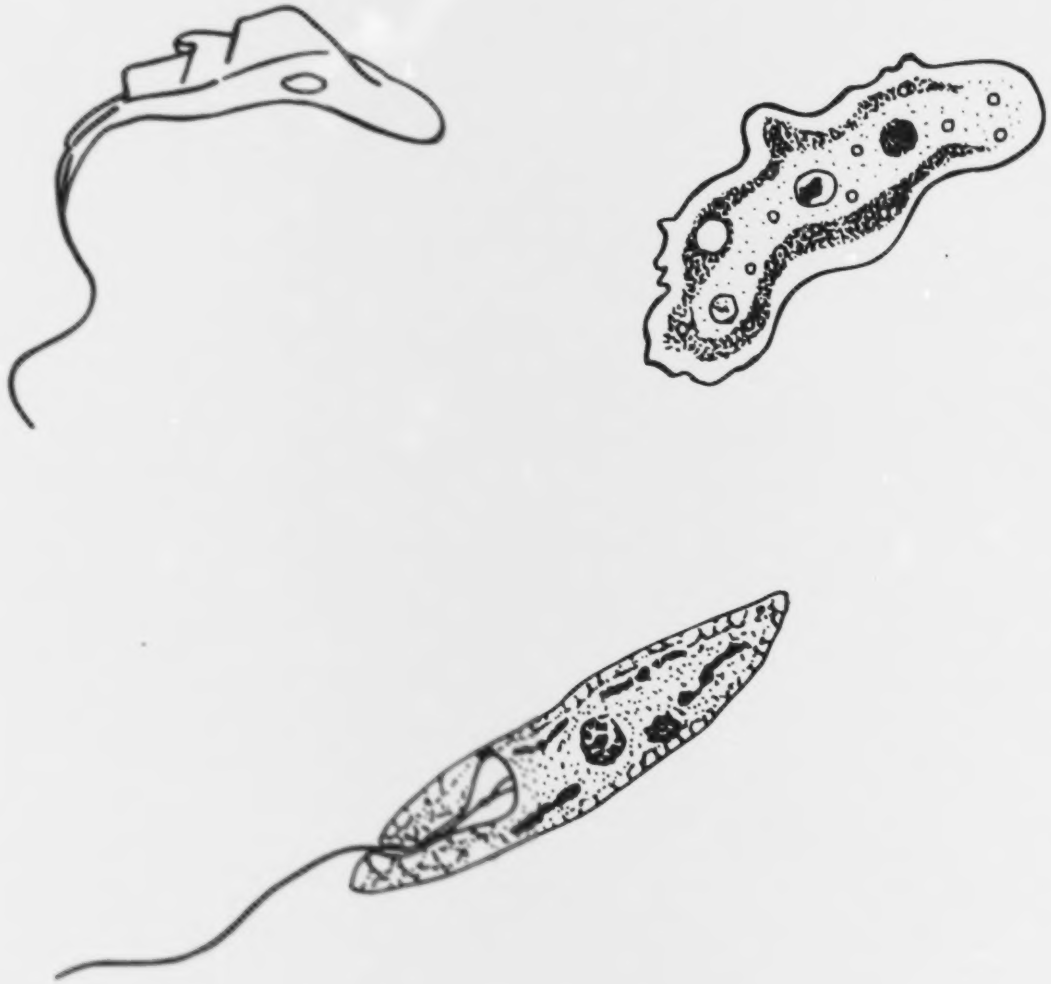
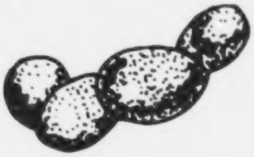
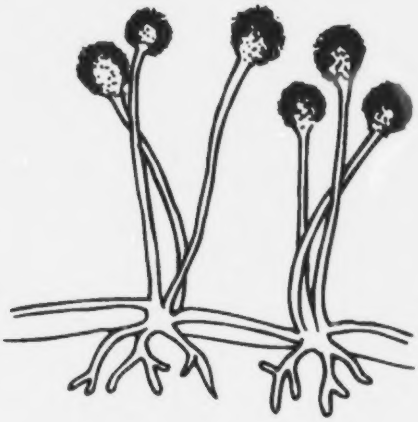
# Protozoa



# Fungi



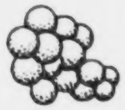
**Yeast Cells**



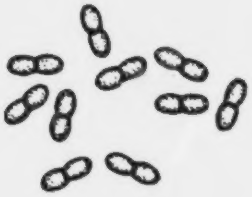
**Molds**

# Bacteria

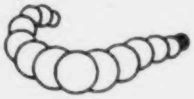
## Sphere-Shaped Forms — Cocci



**Staphylococci**

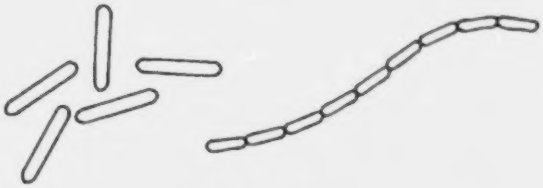


**Diplococci**

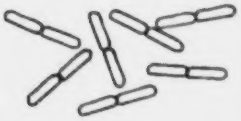


**Streptococci**

## Rod-Shaped Forms — Bacilli

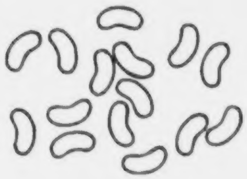


**Streptobacilli**

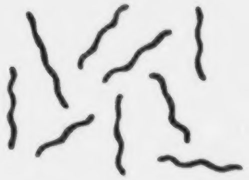


**Diplobacilli**

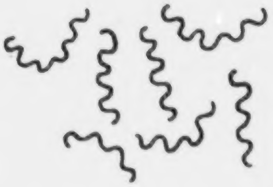
## Spiral-Shaped Forms



**Vibrios**



**Spirilla**



**Spirochetes**

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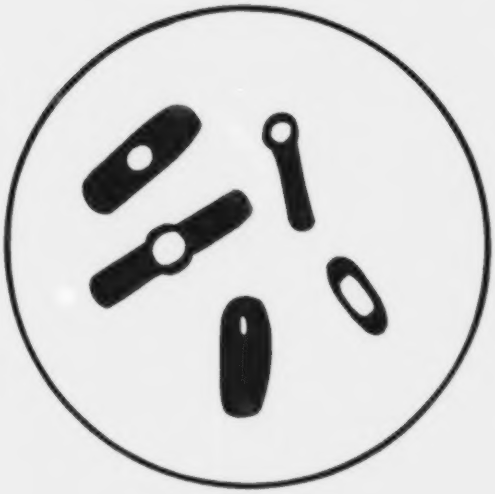
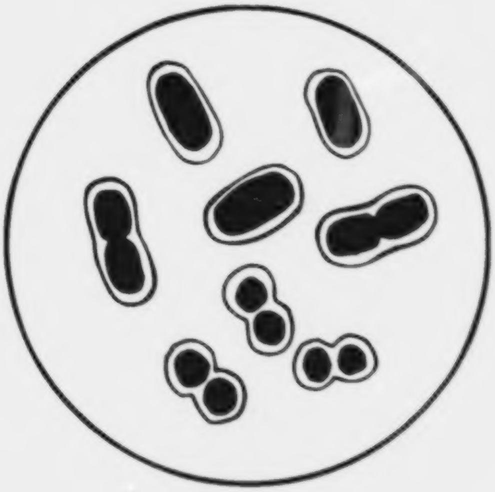
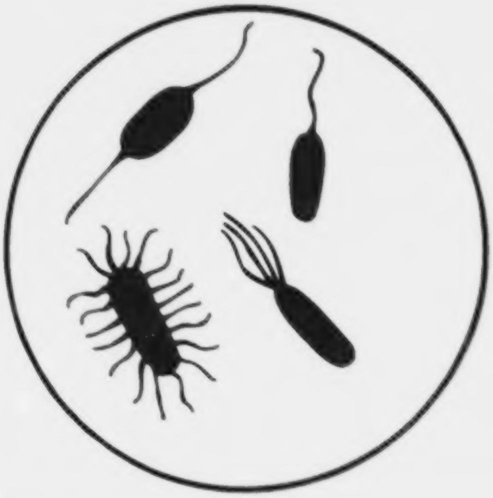
# Specialized Structures of Bacteria



**Spores**
**(white structures)**



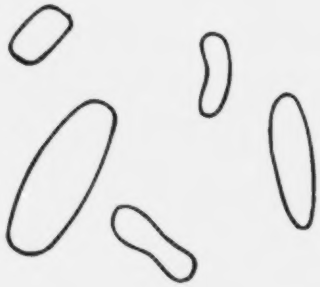
**Capsules**



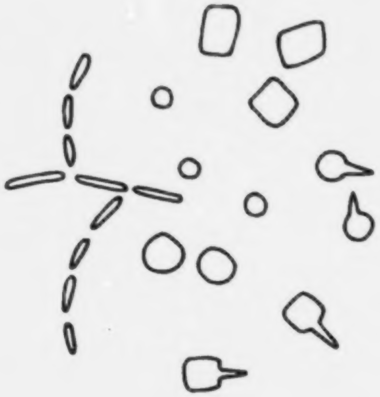
**Flagella**

# Rickettsiae and Viruses

## (As Seen Under an Electron Microscope)



**Rickettsiae**



**Viruses**

## Written Test

Name ____________________________________________

Date ______________________ Score ______________________

**OBJECTIVE 1** Arrange in order the levels of the taxonomy system for classifying organisms. Place a "1" next to the broadest taxonomy, a "2" next to the second broadest, etc.

_____ a. Order
_____ b. Family
_____ c. Kingdom
_____ d. Genus
_____ e. Species
_____ f. Phylum
_____ g. Class

**OBJECTIVE 2** Select major classes of microorganisms by placing an "X" in the appropriate blanks.

Note: Select only the major classes, not specific types.

_____ a. Cocci
_____ b. Spirillae
_____ c. Viruses
_____ d. Rickettsiae
_____ e. Fungi
_____ f. Bacilli
_____ g. Protozoa
_____ h. Molds
_____ i. Bacteria
_____ j. Anaerobes
_____ k. Clostridium

**OBJECTIVE 3** Describe the classes of microorganisms.

a. Bacterium—________________________________________

________________________________________

b. Fungus—________________________________________

________________________________________

c. Protozoan—________________________________________

________________________________________

d. Worm— ________________________________________

________________________________________

e. Virus—________________________________________

________________________________________

**OBJECTIVE 4** Match the types of microbial relationships on the right to their correct descriptions.

_______ a. A relationship between two organisms in which one organism is harmed by the presence of the other

_______ b. A relationship between two organisms in which one organism benefits and the other neither benefits nor is harmed

_______ c. A relationship between two organisms that have close contact with each other

_______ d. A relationship between two organisms that is beneficial to both

_______ e. A relationship between two organisms in which one organism is capable of causing a disease in the other organism

_______ f. One organism produces substances or causes conditions which are lethal for other organisms

_______ g. A relationship between two organisms in which the organisms present no significant benefit or harm to each other

1. Antibiosis
2. Commensalism
3. Mutualism
4. Neutralism or independence
5. Parasitism
6. Pathogenic
7. Symbiosis

**OBJECTIVE 5** Distinguish among normal flora, resident flora, and transient flora by placing the following letters next to their descriptions.

- "N" next to the description of normal flora
- "R" next to the description of resident flora
- "T" next to the description of transient flora

_______ a. Organisms that take up residence in or on the body temporarily in a location where they are not normally found

_______ b. Microscopic plant life such as bacteria which are adapted to residing in a given area of the body during health

_______ c. Organisms that normally live in and on the bodies of healthy persons without causing harm when located in specific sites

**OBJECTIVE 6** Describe the purpose of a gram stain.

______________________________

______________________________

______________________________

______________________________

______________________________

**OBJECTIVE 7** Select true statements concerning the characteristics of bacteria by placing an "X" in the appropriate blanks.

_______ a. Are multicellular

_______ b. Are complex, animal organisms

_______ c. Ordinarily do not contain chlorophyll

_______ d. Have approximately 150 known species and are found only on food

_______ e. Only about 100 species produce disease in human beings

_______ f. Are classified as pathogenic or nonpathogenic

_______ g. Pathogenic bacteria are essential for life and aid in production of some foods and chemicals such as cheeses, sauerkraut, cultured milk products, and lactic acid.

_______ h. Reproduce asexually by budding

_______ i. Have no cell wall

_______ j. The tough outer cell wall provides its shape.

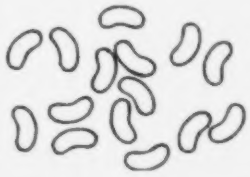
_______ k. Cocci and bacilli often colonize with each other.

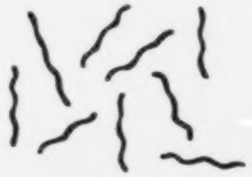
_______ l. Reproduce by meiosis.

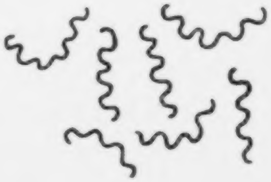
_______ m. Aerobic species can reproduce with or without oxygen

**OBJECTIVE 8** Label types of bacteria according to their shape.

a. Form: ____________________

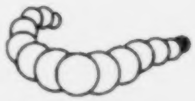


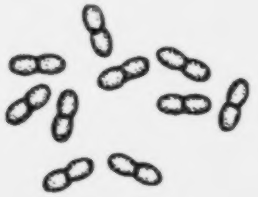


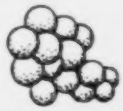


1) ____________________ 2) ____________________ 3) ____________________

b. Form: ____________________

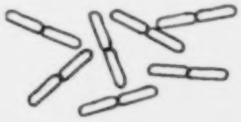


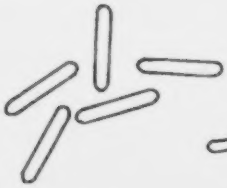


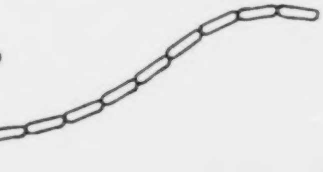


1) ____________________ 2) ____________________ 3) ____________________

c. Form: ____________________







1) ____________________ 2) ____________________

**OBJECTIVE 9** Match specialized structures of bacteria to their correct descriptions. Write the numbers on the blanks provided.

_______ a. Are round structures of condensed protoplasm that are formed within the bacteria

_______ b. Are layers that surround many bacterial cells and interfere with phagocytosis by white blood cells

_______ c. Are hair-like processes that cause the bacteria to move along in liquid by their wavelike rhythmic contractions

1. Capsules
2. Flagella
3. Spores

**OBJECTIVE 10** Distinguish between types of toxins produced by bacteria by placing an "EN" next to the endotoxins and "EX" next to the exotoxins.

_____ a. Diffuse out of the intact bacterial cells into the surrounding medium or tissue

_____ b. Are liberated only when the bacterial cell dies and disintegrates

_____ c. Examples are organisms which cause typhoid fever and bacillary dysentery

_____ d. Examples are organisms which cause tetanus, gas gangrene, diphtheria, and scarlet fever

_____ e. Are the most potent toxins known

**OBJECTIVE 11** Select true statements concerning growth requirements of bacteria by placing an "X" in the appropriate blanks.

_______ a. All bacteria must have some oxygen to live.

_______ b. Moisture delays growth.

_______ c. Autotrophic bacteria use carbon dioxide and other inorganic compounds for food and are nonpathogenic.

_______ d. Heterotrophic bacteria require living or dead organic matter for food and are pathogenic.

_______ e. Parasites utilize dead organic matter for food.

_______ f. Saprophytes utilize living organic matter for food.

_______ g. High heat destroys most bacteria.

_______ h. Most bacteria grow best close to the neutral point on the pH scale or slightly on the alkaline side.

_______ i. Acids do not affect the growth of bacteria.

_______ j. Most bacteria flourish in direct sunlight.

_______ k. Spores are killed by sunlight.

**OBJECTIVE 12** Match the pathogenic bacteria on the right to the correct diseases they cause. Write the numbers on the blanks provided.

_______ a. Most post-operative wound infections

_______ b. Strep throat, scarlet fever, pneumonia, glomerulonephritis, and rheumatic heart disease

_______ c. Gonorrhea

_______ d. Bacterial meningitis

_______ e. Typhoid fever

_______ f. Bacterial dysentery

_______ g. Gastroenteritis, urinary tract infections, pyelonephritis, and epidemic diarrhea in newborn nurseries

_______ h. Whooping cough

_______ i. Tetanus

_______ j. Gas gangrene

_______ k. Botulism

_______ l. Tuberculosis

_______ m. Syphilis

_______ n. Cholera

1. *Bordetella pertussis*
2. *Clostridium botulinum*
3. *Clostridium perfringens*
4. *Clostridium tetani*
5. *Escherichia coli*
6. *Mycobacterium tuberculosis*
7. *Neisseria gonorrhoeae*
8. *Neisseria meningitis*
9. *Pseudomonas aeruginosa*
10. *Salmonella typhi*
11. *Shigella dysenteriae*
12. *Staphylococcus aureus*
13. *Streptococcus pyogenes*
14. *Treponema pallidum*
15. *Vibrio cholerae*

**OBJECTIVE 13** Distinguish between characteristics of fungi and algae by placing an "F" next to the descriptions of fungi and an "A" next to the descriptions of algae.

_____ a. Include yeasts and molds

_____ b. Contain over 100,000 species

_____ c. Some are a common sight on stale bread, rotten fruit, or damp leather.

_____ d. Exist as parasites or saprophytes

_____ e. May be unicellular or multicellular

_____ f. Infestation generally occurs as a result of a break in the skin or a trauma.

_____ g. The most common symptom is skin lesions that resemble many other conditions so that the diagnosis must be confirmed through lab tests.

**OBJECTIVE 14** Distinguish between the characteristics of yeasts and molds by placing an "X" next to the descriptions of molds.

_____ a. Are characterized by a fuzzy growth of interlacing filaments called *hyphae*

_____ b. Reproduce by spores

_____ c. Reproduce by budding

_____ d. Some may be seen on foods such as bread and cheese.

_____ e. Some are used commercially in preparing beer, wine, and breads.

_____ f. Are unicellular, microscopic organisms

_____ g. Are multicellular

_____ h. A common mycosis of this is caused by *Candida albicans*.

_____ i. A common mycosis of this is caused by *Tinea capitis*.

**OBJECTIVE 15** Select true statements concerning characteristics of protozoa by placing an "X" in the appropriate blanks.

_____ a. Are multicellular

_____ b. Are simple forms of plant life

_____ c. Are microscopic

_____ d. Take their food in solid particles

_____ e. Are nonmotile

_____ f. Reproduce sexually or asexually by fission

_____ g. When subjected to adverse conditions, they become very active.

**OBJECTIVE 16**

Match the protozoan diseases on the right to their correct causes and characteristics. Write the numbers on the blanks provided.

______ a. Transmitted by the bite of a female *Anopheles* mosquito or by a contaminated hypodermic needle or blood transfusion

______ b. Caused by *Entamoeba histolytica*

______ c. Characterized in women by vaginitis with a profuse, cream-colored, foul-smelling discharge

______ d. Transmitted by sexual intercourse, contaminated douche equipment, contaminated examination instruments, and contaminated towels

______ e. Characterized by chills and fever

______ f. Occurs following fecal contamination of food or drink

______ g. Symptoms are intense diarrhea with bloody, mucous-filled stools

______ h. Caused by a parasite of the *Plasmodium* genus (several species)

______ i. Caused by drinking water containing giardia

______ j. Symptoms include diarrhea

1. Amebic dysentery
2. Giardiasis
3. Malaria
4. Trichomonas infection

**OBJECTIVE 17**

Complete the following statements concerning the characteristics of rickettsiae. Write your answers on the blank lines provided in the statements below.

a. Are much smaller than bacteria, but larger than ______________________

b. Are ______________________ (can only grow inside living cells)

c. Are transmitted to human beings by ______________________

**OBJECTIVE 18**

List two diseases caused by rickettsiae.

a. ______________________

b. ______________________

**OBJECTIVE 19**

Select true statements concerning characteristics of helminths by placing an "X" in the appropriate blanks.

_____ a. Are unicellular

_____ b. Are plant parasites

_____ c. Are animal parasites

_____ d. Are commonly called worms

_____ e. Are transmitted through fecal contamination or by eating some uncooked meats such as pork

_____ f. Parasitic worms generally inhabit specific body sites.

_____ g. Mites and lice generally afflict the inner body structures of a host's body and present great direct risk to the host.

_____ h. Parasites such as lice, fleas, mosquitoes, and ticks may be vectors of disease.

**OBJECTIVE 20** List common parasites that afflict humans.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

**OBJECTIVE 21** Complete the following statements concerning characteristics of viruses by circling the correct answers.

a. Smallest organism known; can only be seen with the aid of **(an electron, a simple, a compound)** microscope.

b. Are very **(complex, simple)**

c. Are **(saprophytes, parasites)**

d. Viruses of human beings and animals are generally **(rod-shaped, spherical)** in shape.

e. Viruses of plants are **(rod-shaped, spherical)** in shape.

f. Viruses have **(many, no)** metabolic functions of their own.

g. **(Bacteriophages, Inclusion bodies)** are found in host cells that have been affected by a virus.

h. Interferon **(increases, blocks)** the effect of the virus.

i. Viruses are transmitted **(only by direct, only by indirect, by both direct and indirect)** contact.

j. Each virus exhibits a **(form, shape)** that is characteristic of that virus.

k. Viruses can only reproduce when they are **(within the living cells of a host, outside the host cell)**.

l. The severity of a viral disease depends on the **(type, number)** of cells that are infected.

**OBJECTIVE 22** List viral diseases according to each type.

a. Dermotrophic viruses

1) ______________________________

2) ______________________________

b. Pneumotrophic viruses

1) ______________________________

2) ______________________________

c. Neurotrophic viruses

1) ______________________________

2) ______________________________

d. Viscerotrophic viruses

1) ______________________________

2) ______________________________

e. Immunotrophic— ______________________________

***Permission to duplicate this test is granted.**

# Introduction to Surgical Technology
# Section C: Microbiology
# Module 1-C: Introduction to Microbiology

## Answers to Written Test

**Objective 1**

a. 4
b. 5
c. 1
d. 6
e. 7
f. 2
g. 3

**Objective 2**

c, d, e, g, i

**Objective 3**

a. A widely distributed unicellular organism that may or may not cause disease
b. A unicellular or multicellular organism that reproduces by means of spores and that may be pathogenic or nonpathogenic
c. A unicellular organism that is adapted for life in water and forms cysts that pass from host to host
d. A multicellular organism that in its parasitic form can be pathogenic to humans
e. A subcellular organism that reproduces as a parasite within other organisms and, consequently, is pathogenic

**Objective 4**

a. 5
b. 2
c. 7
d. 3
e. 6
f. 1
g. 4

**Objective 5**

a. T
b. N
c. R

**Objective 6**

The purpose of a gram stain is to identify the shape of a pathogen to aid in preliminary identification of the organism. The shape and color of the organism can be identified under the microscope to determine if the organism is gram positive or gram negative.

**Objective 7**

c, e, f, j, k

**Objective 8**

a. Spiral or curved
   1) Vibrios
   2) Spirilla
   3) Spirochetes

b. Sphere or round (Coccus)
   1) Streptococci
   2) Diplococci
   3) Staphylococci

c. Rod or cylinder (Bacillus)
   1) Diplobacilli
   2) Streptobacilli

**Objective 9**

a. 3
b. 1
c. 2

**Objective 10**

a. EX
b. EN
c. EN
d. EX
e. EX

**Objective 11**

c, d, g, h

**Objective 12**

a. 12
b. 13
c. 7
d. 8
e. 10
f. 11
g. 5
h. 1
i. 4
j. 3
k. 2
l. 6
m. 14
n. 15

**Objective 13**

a. F
b. F
c. F
d. F
e. F and A
f. A
g. A

**Objective 14**

a, b, d, g, i

**Objective 15**

c, d, f

**OBJECTIVE 16**

a. 3
b. 1
c. 4
d. 4
e. 3
f. 1
g. 1
h. 3
i. 2
j. 2

**OBJECTIVE 17**

a. viruses
b. parasites
c. arthropods (insects or animal vectors such as lice, mice, fleas, rats, and ticks)

**OBJECTIVE 18**

Any two of the following. Answers may appear in any order:
a. Rocky Mountain spotted fever
b. Endemic (flea-bourne)
c. Epidemic (louse-borne) typhus

**OBJECTIVE 19**

c, d, e, f, h

**OBJECTIVE 20**

Answers may appear in any order:
a. Roundworms
b. Pinworms
c. Hookworms
d. Trichinellae
e. Flatworms

**OBJECTIVE 21**

a. an electron
b. complex
c. parasites
d. spherical
e. rod-shaped
f. no
g. inclusion bodies
h. blocks
i. by both direct and indirect
j. shape
k. within the living cells of a host
l. type

**OBJECTIVE 22**

Students may list other viral diseases that were not included in this module. Evaluate them on an individual basis.

a. Any two of the following:
   1) Smallpox—*Variola* virus
   2) Chickenpox—*Varicella* virus
   3) Measles—*Rubeola* virus
   4) German measles—*Rubella* virus
   5) Fever blisters—*Herpes simplex* virus
   6) Shingles (Herpes zoster)—*Varicella-zoster* virus

b. Any two of the following:
   1) Common cold (coryza)
   2) Influenza
   3) Infectious mononucleosis
   4) Viral pneumonia

c. Any two of the following:
   1) Poliomyelitis
   2) Rabies
   3) Encephalitis

d. Any two of the following:
   1) Mumps
   2) Viral hepatitis
   3) Yellow fever

e. AIDS-HIV

## Module Review

Name ______________________________

Date ________________ Score ________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 5

1. What are organisms that take up residence in or on the body temporarily in a location where they are not normally found called?

   a. normal flora

   b. resident flora

   c. transient flora

   d. parasitic flora

Objective 22

2. Viral pneumonia is an example of what type of virus that affects the respiratory tract?

   a. immunotrophic

   b. viscerotrophic

   c. neurotrophic

   d. pneumotrophic

Objective 1

3. Which of the following is the lowest level in the taxonomy system?

   a. kingdom

   b. order

   c. phylum

   d. species

Objective 19

4. What are helminths commonly called?

   a. yeast

   b. mold

   c. worms

   d. bugs

Objective 2

5. Which of the following is NOT a major class of microorganism?

   a. bacteria

   b. class

   c. fungi

   d. viruses

Objective 7

6. Which of the following statements is FALSE concerning bacteria?

   a. are simple plant organisms

   b. produce diseases in humans

   c. thin outer cell wall provides its shape

   d. reproduce by binary fission

Objective 3

7. Which class of microorganism in its parasitic form can be pathogenic to humans?

   a. bacterium

   b. fungus

   c. helminths

   d. protozoan

Objective 11

8. Which of the following is NOT a growth requirement of bacteria?

   a. darkness

   b. food

   c. moisture

   d. light

Objective 3

9. What class of microorganism consists of distinctly shaped DNA or RNA within a protein shell and causes diseases such as chicken pox, measles, and rabies?

   a. bacterium

   b. fungus

   c. protozoan

   d. virus

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Objective 4

10. What is a relationship between two organisms that have close contact with each other called?

a. actuary
b. antibiosis
c. commensalism
d. symbiosis

Objective 1

11. According to the taxonomy system for classifying organisms, which of the following is the highest listed level?

a. class
b. family
c. genus
d. kingdom

Objective 5

12. What are microscopic plant life such as bacteria which are adapted to residing in a given area of the body during health called?

a. normal flora
b. resident flora
c. transient flora
d. parasitic flora

Objective 6

13. What is the laboratory technique used to identify bacteria which consists of staining bacteria with a violet stain and then counterstaining called?

a. alph-chymar stain
b. gram-positive bacteria stain
c. gram stain
d. culture

Objective 20

14. What do roundworms, pinworms, hookworms, and trichinellae have in common?

a. are all common bacteria that afflict animals
b. are all common parasites that afflict humans
c. are all types of viruses
d. are all types of protozoa

Objective 8

15. What type of bacteria are characterized by chain formation?

a. diplococcus
b. diplobacilli
c. staphylococcus
d. streptococcus

Objective 21

16. Which of the following are nucleic acids within shells of protein, can only reproduce when they are within the living cells of a host organism, and the severity of the disease depends on the type of cells that are infected?

a. bacteria
b. protozoa
c. viruses
d. parasites

Objective 21

17. What is the smallest organism known?

a. virus
b. bacteria
c. fungi
d. algae

Objective 9

18. Which of the following are specialized structures of bacteria that are hair-like processes that cause the bacteria to move along in liquid by their wavelike rhythmic contractions?

a. capsules
b. flagella
c. spores
d. pathogenic

Objective 12

19. Which of the following strains of bacteria causes food poisoning?

a. *Staphylococcus aureus*
b. *Salmonella typhi*
c. *Staphylococci*
d. *Streptococcus pyogenes*

Objective 7

20. Which of the following terms is defined as having the capability to live under certain environmental circumstances and having the ability to adapt to more than one condition?

   a. culture

   b. facultative

   c. anaerobe

   d. host

Objective 13

21. Which of the following statements is FALSE concerning fungi?

   a. are in the plant kingdom

   b. include yeasts and molds

   c. contain over 100,000 species

   d. contain chlorophyll

Objective 6

22. Which of the following is NOT an example of a gram-positive bacteria?

   a. streptococcus

   b. proteus

   c. clostridium

   d. staphylococcus

Objective 13

23. Which of the following statements is FALSE concerning algae?

   a. contains chlorophyll

   b. are only unicellular

   c. infestation generally occurs as a result of break in skin

   d. can produce its own nourishment in the presence of light

Objective 16

24. Which of the following is transmitted by the bite of a female *Anopheles* mosquito?

   a. amebic dysentery

   b. malaria

   c. giardiasis

   d. chicken pox

Objective 14

25. Which of the following statements is TRUE concerning yeast?

    a. reproduce by spores
    b. are multicellular
    c. causes ringworm of the scalp
    d. some are used commercially in preparing beer, wine, and breads

Objective 8

26. What are spiral or curved forms of bacteria called?

    a. diplococci
    b. spore
    c. streptobacilli
    d. vibros

Objective 15

27. What term is used to describe a capsule that forms around microorganisms before they enter dormant periods?

    a. protozoa
    b. cyst
    c. pseudopod
    d. cilia

Objective 10

28. Which type of toxin produced by bacteria are liberated only when the bacterial cell dies and disintegrates, are contained in bacterial cell walls, and cause typhoid fever?

    a. amino toxin
    b. endotoxin
    c. exotoxin
    d. heterotrophic toxin

Objective 8

29. Which of the following are rod or cylinder shaped bacteria?

    a. bacillus
    b. coccus
    c. spirilla
    d. spirochetes

Objective 4

30. Squirrels and songbirds that live in the same tree are examples of which type of microbial relationship?

    a. antibiosis

    b. symbiosis

    c. independence

    d. commensalism

Objective 12

31. What does *Pseudomonas aeruginosa* cause?

    a. severe wound infections

    b. gas gangrene

    c. tetanus

    d. whooping cough

Objective 16

32. Which of the following is caused by *Entamoeba histolytica*?

    a. malaria

    b. giardiasis

    c. amebic dysentery

    d. trichomonas infection

Objective 9

33. Which of the following are specialized structures of bacteria that are inactive, are not reproductive forms, and resist drying and most chemical disinfectants?

    a. capsules

    b. flagella

    c. spores

    d. pathogenic

Objective 17

34. Which of the following statements is TRUE of rickettsiae?

    a. are much larger than bacteria, but smaller than viruses

    b. are parasites

    c. can only grow outside living cells

    d. are transmitted to humans through the air

Objective 14

35. Which of the following statements is TRUE of thrush?

   a. seen commonly in newborns infected by the mother
   b. infects mucous membranes of the mouth
   c. caused by common yeast mycosis called Candida albicans
   d. all of the above

Objective 19

36. Which of the following statements is FALSE concerning helminths?

   a. are unicellular animal parasites
   b. are the largest organism responsible for human disease
   c. are transmitted through fecal contamination or by eating uncooked meat
   d. live off nutrients in the host's body

Objective 15

37. Which of the following are unicellular, simple forms of animal life, microscopic, and reproduce sexually or asexually by fission?

   a. protozoa
   b. yeast
   c. mold
   d. algae

Objective 22

38. Which of the following is a dermotrophic virus?

   a. Coryza
   b. Varicella virus
   c. Rabies
   d. AIDS

Objective 14

39. Which of the following statements is TRUE concerning molds?

   a. are unicellular, microscopic organisms
   b. reproduce by budding
   c. characterized by a fuzzy growth of interlacing filaments called hyphae
   d. causes ringworm of the foot

Objective 18

40. What illness is caused by *Rickettsia ricketsii*?

   a. Rocky Mountain spotted fever

   b. Endemic typhus

   c. Epidemic typhus

   d. Flea-borne typhus

*Permission to duplicate this module review is granted.

## Answers to Module Review

1. c
2. d
3. a
4. c
5. b
6. c
7. c
8. d
9. d
10. d
11. c
12. a
13. c
14. b
15. d
16. c
17. a
18. b
19. c
20. b
21. d
22. b
23. b
24. b
25. d
26. d
27. b
28. b
29. a
30. c
31. a
32. c
33. c
34. b
35. d
36. a
37. a
38. b
39. d
40. a

# Introduction to Surgical Technology

## SECTION C:
## Microbiology

### Module 2-C: Infection and Immunology

## Introduction to Surgical Technology
## Section C: Microbiology
## Module 2-C: Infection and Immunology

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module" and "Suggested Web Sites" for more information.
- Make copies of any teacher supplements that will be provided for each student.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where

applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.

- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to teach students about infections and the body's defense mechanisms.

- Introduce the module by sprinkling "Glo-Germ" powder, which will not be visible to the students, on each student's desk prior to class. After a few minutes of class, stop and have students examine their hands and arms under the "Glo-Germ" light. This will illustrate how quickly some germs are spread and how crucial hands are to this transmission. The address for "Glo-Germ" follows in the Suggested Supplemental Resources.
- Invite an epidemiologist and/or a representative of a local hospital's infection control committee to talk to your class about ways of controlling the spread of infection in the hospital.
- Divide the class into groups and assign each a disease and have them discuss and present to the class the following:
  - — Description of the disease and its course (acute or chronic)
  - — Symptoms and phases
  - — Type of disease (primary, etc.)
  - — Mode of transmission
  - — Portal of entry
  - — Portal of exit
  - — Precautions to prevent portal of entry and exit identifying those that are considered standard precautions
- Review the module by use of a game such as "Jeopardy" or "Family Feud" using questions from the Written Test and Module Review.
- Have students prepare cultures from their hands for identification of organisms present. You may want to culture both washed and unwashed hands for comparison. Stress to students how hand washing is the most important means for controlling the transmission of infection.

- Discuss pathogens common to the operating room environment. Refer to Teacher Supplement 1 for a partial listing. Discuss the transmission methods and how transmission can be prevented.
- Discuss the transmission of hepatitis and HIV. Teacher Supplements 2 and 3 provide more information on this. You may wish to make copies for the students for discussion and/or quizzes of the information. These are optional activities that could be used if time allows.
- Discuss the importance of a healthy immune system and how the immune system fights diseases.
- Play the "bid game" to review the content of this module.
    - Pass out 3x5 cards and have each student write two questions for each objective. The question should be put on one side and the answer on the back. The questions must be grammatically correct. Each question must be able to be answered with one or two words.
    - Take up the questions and use them to play "bid."

      ✓ **NOTE:** It is best to have the questions handed in by the end of one class period for review during the next class. An option is to use your own questions.
    - Divide the class into two teams. Each team chooses a captain. The captain is the only one that may talk to the teacher. He/She bids for and presents the team's answers.
    - Both teams start with 500 points. The teacher prepares the question and assigns points for each question.
    - Announce the point value of the first question. The teams have 30 seconds to **WRITE** down their bid which is presented to the teacher by the captain.
    - The question is read and the highest bidding team is given 30 seconds to discuss and then answer the question. The captain must be the one to answer. If the team fails to correctly answer the question, it goes to the other team for the same number of points, and **the points are subtracted from the team with the incorrect answer.**
    - At the end of the time limit for the game, the team with the most points wins.
- After completion of Assignment Sheet 2:
    - Discuss the vaccinations that are required for health care workers. Also discuss why they may not have had all of the vaccinations listed on Assignment Sheet 2. For example, HIB has only been recommended for infants since 1990.
    - Encourage any student with severe allergic (anaphylactic) reactions to wear medical alert tags. Discuss how these can save lives.
- Contact your local county, state, or federal health departments for up-to-date information about vaccinations recommended or required for health care workers.

  U.S. Department of Health and Human Services
  Public Health Service
  Centers for Disease Control
  Atlanta, GA 30333

- A major concern of your students will be AIDS and the spread of HIV. If not already covered in your course, plan how you will discuss the topic and how the subject will fit into the overall presentation.

- Provide students with copies of the book *A Commotion in the Blood: Life, Death, and the Immune System* by Stephen S. Hall, or provide similar resources that can supplement this module. Use the books as they relate to specific objectives and to support completion of the assignment sheet.

- Ask students if any of them have ever had an infection and ask them to explain what they think an infection is. Guide them to an understanding of the definition used in your course. Use their range of experiences to help them understand the broad application of the term. Some may, for example, think that an infection only occurs when there is redness and pus in a sore. Use what they have learned about cells and microbiology in the previous modules to explain the action of pathogens.

- Discuss the infection process and introduce concepts related to the spread of infection within a host. Relate terms like incubation period and resistance to experiences that the students have had, such as one member of their family getting a cold followed in the next few days of others getting or not getting colds. Use this opportunity to encourage students to help maintain their resistance through good diet, exercise, getting plenty of rest (instead of cramming for tests), and proper precautions, including frequent thorough handwashing.

- Introduce students to various types of infections and diseases, some of which may be new to them. Provide the students with illustrations of persons infected with the diseases discussed to help them understand about symptoms and the course of infection. For example, show persons in early stages and in advanced stages of tuberculosis.

- In the discussion of phases of a disease, help the students to understand that the health-care professional's goal is to bring about efficient convalescence with as little suffering or loss of body functions as possible; stress that this is not always possible. Provide anecdotes or have other health-care professionals share stories of their victories and losses.

- In discussing the portals of entry and exit, the students have a chance to examine their own vulnerabilities. Relate incidents of contamination when a health-care professional was confident that adequate protection had been provided to both the patient and attending personnel. Introduce precaution procedures and equipment briefly to help students understand that protection is a team effort.

- Use illustrations or actual equipment with a blacklight system or other process to reveal the contamination of living hosts in inanimate objects. Have the students discuss how they could handle objects without spreading the contamination. Role play a few scenes in which bed linens are soiled, instruments must be passed, patients have to be moved, etc., to get students thinking about control of infectious contamination.

- The objective on factors that determine whether a pathogen will cause a disease should now offer an opportunity for lively discussion. Encourage the students to expand on each factor and to consider the influences of the patient, the facility, caregivers, medical treatment, and other circumstances that make the factor more or less significant.

- Use illustrations or demonstrations to discuss the body's physical barriers. Ensure that your demonstrations represent good practices. For example, water can be used to represent perspiration, saliva, and tears. Discuss natural flora, building on or recalling your presentation from the previous module.

- Discuss immunology and types of immunity. Discuss types of diseases that are specific to humans or other species, that are specific to races and cultures, and that are more likely to occur in offspring if a parent exhibits the disease. Ensure that the student recognizes that two types of differentiation are being made: the type of acquisition (natural or artificial) and the type of immunity (active or passive).

- Provide an overview of the major cellular and tissue defense mechanisms, while the subsequent objectives provide additional details about each type of defense response. Help the students understand how the objectives relate to the types of defense mechanisms as you provide instruction.

- Provide illustrations of the defense mechanisms to allow the students to visualize each. Numerous videotapes are available that show phagocytosis and serum responses. Your purpose here is to get the students to make an at-large correlation between the defense mechanisms and their response sites and components involved so that the following material will fall into place more easily.

- Provide illustrations of the various type of white blood cells. Point out that further information will be presented about the components of blood in later modules, but since an important role of blood is to fight infections, that aspect of blood must be discussed here. Point out that white blood cells are involved in a number of ways in the various types of defense mechanisms, particularly monocytes and lymphocytes.

- Remind students that lymphocytes are a type of white blood cell involved in the defense response in two broad categories based on their origin. While B cells are actually so designated due to their discovery in chicken bursae, it is convenient to help distinguish between T cells and B cells by relating the T to *thymus* and the B to *bones*.

- Use illustrations and videotapes to explain the action of T cells and B cells in a general way, basically to get students to recognize that they perform specialized functions. Then relate T cells to cell-mediated immunity and B cells to humoral- or antibody-mediated immunity. Again, the B might be helpful in remembering antiBody. Continue the discussion by covering what happens in each type of immunity development. Then relate the phases of antibody development to humoral-mediated immunity development.

- Remind students of what they have previously learned about inflammation. Then relate the process to controlling the spread of disease. Help the students understand the role of the cells that accumulate in an inflamed site based on the discussion in the preceding objectives.

- Have health-care professionals discuss their experiences with nosocomial infections. Role play some of the procedures to allow students to get a sense of improper techniques and a false sense of security. For example, you may have one set of students demonstrate patient care with the risk of nosocomial infection and have other students observe and identify potential problems with the methods used.

- Also, provide illustrations of the various types of nosocomial organisms and discuss the risks they represent, as well as the effectiveness of precautions in relation to specific infectious agents.

- Demonstrate and have students practice the recommended precautions. Tailor the presentation to local practices and equipment. Emphasize the need to accommodate surgical procedures, patient's condition and secondary factors (HIV-positive or active tuberculosis), facility practices, and other issues when planning surgical-suite procedures. Have students discuss the reasoning behind these procedures. For example, ask why used needles should not be recapped or why staples may be preferred over sutures.

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- Sherris, David A., and Eugene B. Kern. *Basic Surgical Skills*. Rochester, MN: Mayo Foundation for Medical Education and Research, 1999.
- Thibodeau, Gary A., and Kevin T. Patton. *Anatomy and Physiology*. 4th ed. St. Louis: Mosby, Inc., 1999.

### SUGGESTED SUPPLEMENTAL RESOURCES

- Hall, Stephen S. *A Commotion in the Blood: Life, Death, and the Immune System*. New York: Henry Holt and Company, 1997.

  This book is a well-told story of the advances made in immunology through the 20th Century. It is excellent source material for student reports and case studies.

- Glo-Germ Company (for Glo-Germ powder required in Teaching Suggestions)
  P.O. Box 189
  Moab, UT 84532
  800-842-6622
  www.glogerm.com

- American Liver Foundation (for free information about hepatitis)
  75 Maiden Lane, Suite 603
  New York, NY 10038
  800-465-4837
  888.443-7872
  www.liverfoundation.org/

- *Clinical Microbiology Newsletter* (ISBN 0196-4399) Published twice monthly

  Elsevier Science Publishing Co.
  Regional Sales Office
  Customer Support Department
  P.O. Box 945
  New York, NY 10159-0945
  888-437-4636
  www.elsevier.com/

- *Infection Control Rounds* (complimentary newsletter for health care professionals)

Infection Control Rounds
3M Health Care Services
2982 Cleveland Avenue N.
Roseville, MN 55113
800-228-3957
Fax: 651-604-0214
www.3M.com/healthcare

**Multimedia**

- The following companies offers a multitude of health-related videos and CD-ROMs.

AIMS Multimedia
9710 DeSoto Avenue
Chatsworth, CA 91311-4409
800-367-2467
www.aimsmultimedia.com

Medcom, Inc.
6060 Phyllis Drive
Cypress, CA 90630
800-877-1443
www.medcominc.com

Insight Media Inc.
2162 Broadway
New York, NY 10024-0621
800-233-9910
www.insight-media.com

Films for the Humanities and Sciences
PO Box 2053
Princeton, NJ 08543-2053
800-257-5126
www.films.com

**SUGGESTED WEB SITES***

✔ **NOTE:** Some of the following Web sites offer general information concerning anatomy and physiology while others offer information on infection and immunology.

- http://harveyproject.org

The Harvey Project is an international collaboration of educators, researchers, physicians, students, programmers, instructional designers, and graphic artists working together to build interactive, dynamic human physiology course materials on the World Wide Web. Materials produced by the Harvey Project are available free to educational institutions. The site is constantly updated and should be checked often and browsed for overall content. The address provided is for the home page. By clicking the WEB button, you will be taken to an index of links divided into categories such as general physiology and specific systems. The number of links in each category is indicated in parentheses after the topic.

- http://merck.com/health/

  This site provide a general guide to health that addresses many disorders.

- http://iai.asm.org/

  This Web site contains journal articles related to infection and immunity.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

## Teacher Supplement 1—Pathogens Common to the Operating Room Environment

| Microorganism | Usual Environment | Transmission |
|---|---|---|
| Staphylococci | Skin, hair<br>Upper respiratory tract | Direct contact<br>Airborne |
| *Escherichia coli* | Intestinal tract<br>Urinary tract | Feces, urine<br>Direct contact |
| Streptococci | Oronasopharynx<br>Skin, perianal | Airborne<br>Direct contact |
| *Tubercle bacillus (Mycobacterium tuberculosis)* | Respiratory tract<br>Urinary tract | Airborne, droplet<br>Direct contact |
| *Pseudomonas aeruginosa* | Urinary tract<br>Intestinal tract<br>Water | Direct contact<br>Urine, feces<br>Water |
| *Serratia marcescens* | Urinary tract<br>Respiratory tract | Direct contact<br>Water |
| *Clostridium* | Intestinal tract | Direct contact |
| *Fungi* | Dust, soil<br>Inanimate objects | Airborne<br>Direct contact |
| *Hepatitis virus* | Blood<br>Body fluids | Bloodborne<br>Direct contact |

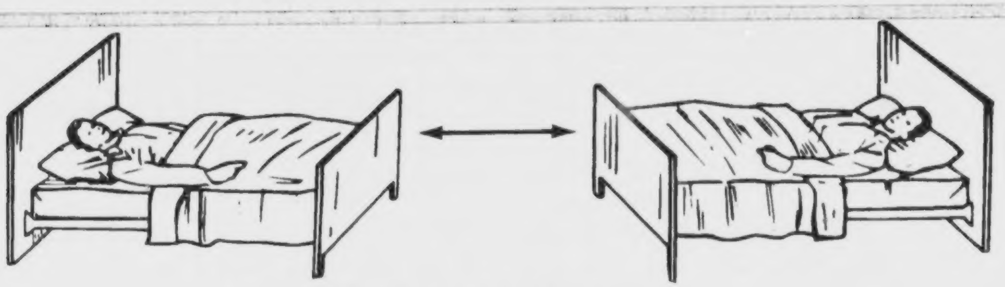
## Teacher Supplement 2—Types of Viral Hepatitis

| Virus | Transmission | Precaution/Prevention | Comments |
|---|---|---|---|
| Hepatitis A (HAV) | Oral/fecal | Good sanitation - hand washing | Usually see outbreaks associated with restaurant workers. |
| Hepatitis B (HBV) | Blood/STD | Protective Barriers - Standard Precautions<br>Vaccine - series of 3 | Of concern to OR personnel due to blood transmission. This disease can be fatal. |
| Hepatitis C (HCV) | Blood/transfusion associated | Protective Barriers - Standard Precautions | Of concern but is transfusion-associated and documentation does not indicate that it is a major threat to health care workers. |
| Hepatitis D (HDV) | Blood/co-infector with HBV | Protective Barriers - Standard Precautions<br>Vaccine for HBV | One must have HBV for HDV to attack. It increases the severity and mortality of hepatitis. |
| Hepatitis E (HEV) | Oral/fecal | Good sanitation - hand washing | Seen in underdeveloped countries with poor sanitation as endemic. |

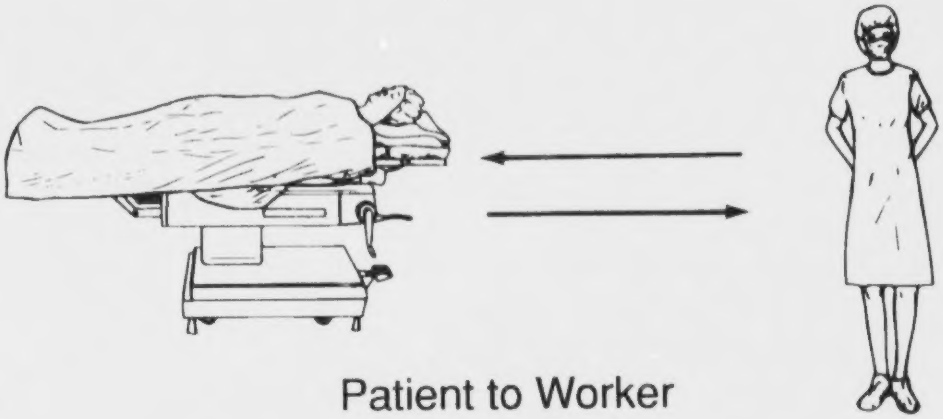
## Teacher Supplement 3—Comparison of HIV and HBV

| | HIV | HBV |
|---|---|---|
| **Transmission** | Sexual contact<br>Parenteral<br>Perinatal | Sexual contact<br>Parenteral<br>Perinatal |
| **Incubation** | 5—6 days to get through blood stream<br>2 weeks to 2 months to show positive test<br>Up to 10+ years asymptomatic | 40–180 days |
| **Symptoms** | HIV + (asymptomatic)<br>American Red Cross flu symptoms<br>Aids opportunistic diseases | One-third of patients asymptomatic<br>Flu symptoms<br>Acute jaundice |
| **Prognosis** | Death | Complete recovery, 6 months<br>Chronic carrier<br>Complications such as<br>• Cirrhosis<br>• Liver cancer<br>• Chronic liver disease<br>Death |

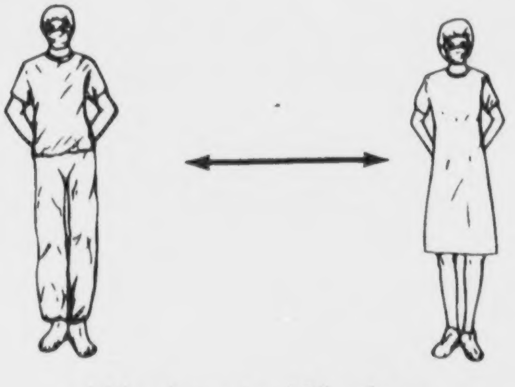
# Direct Contact



Patient to Patient

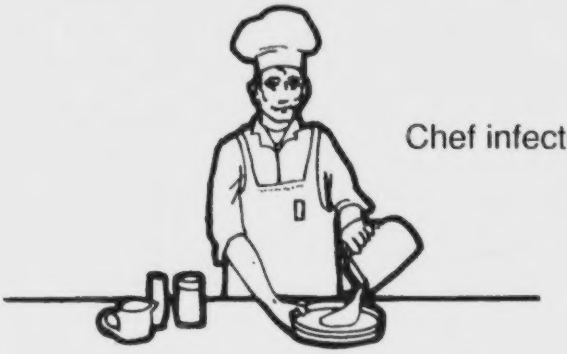


Patient to Worker
Worker to Patient



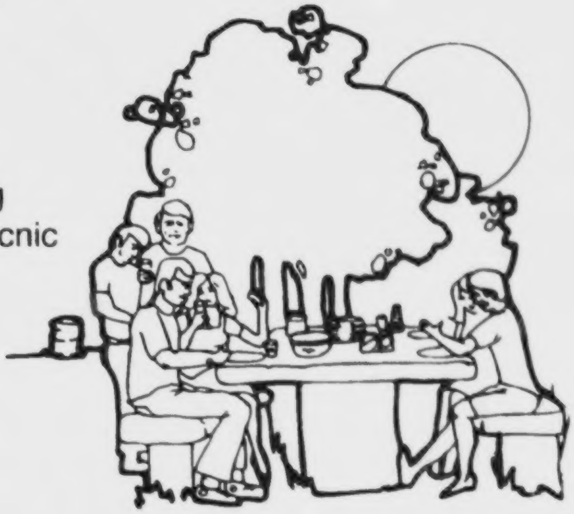
Worker to Worker

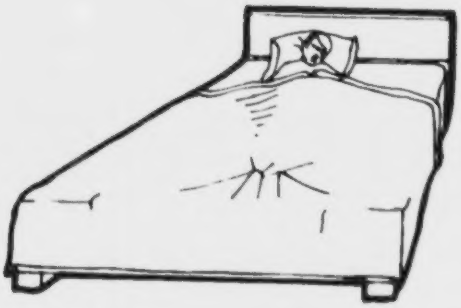
# Indirect Contact
## (Through Food)



Chef infected with *Staphylococci*

Pies purchased in morning and eaten at 5 p.m. at a picnic attended by 60 people

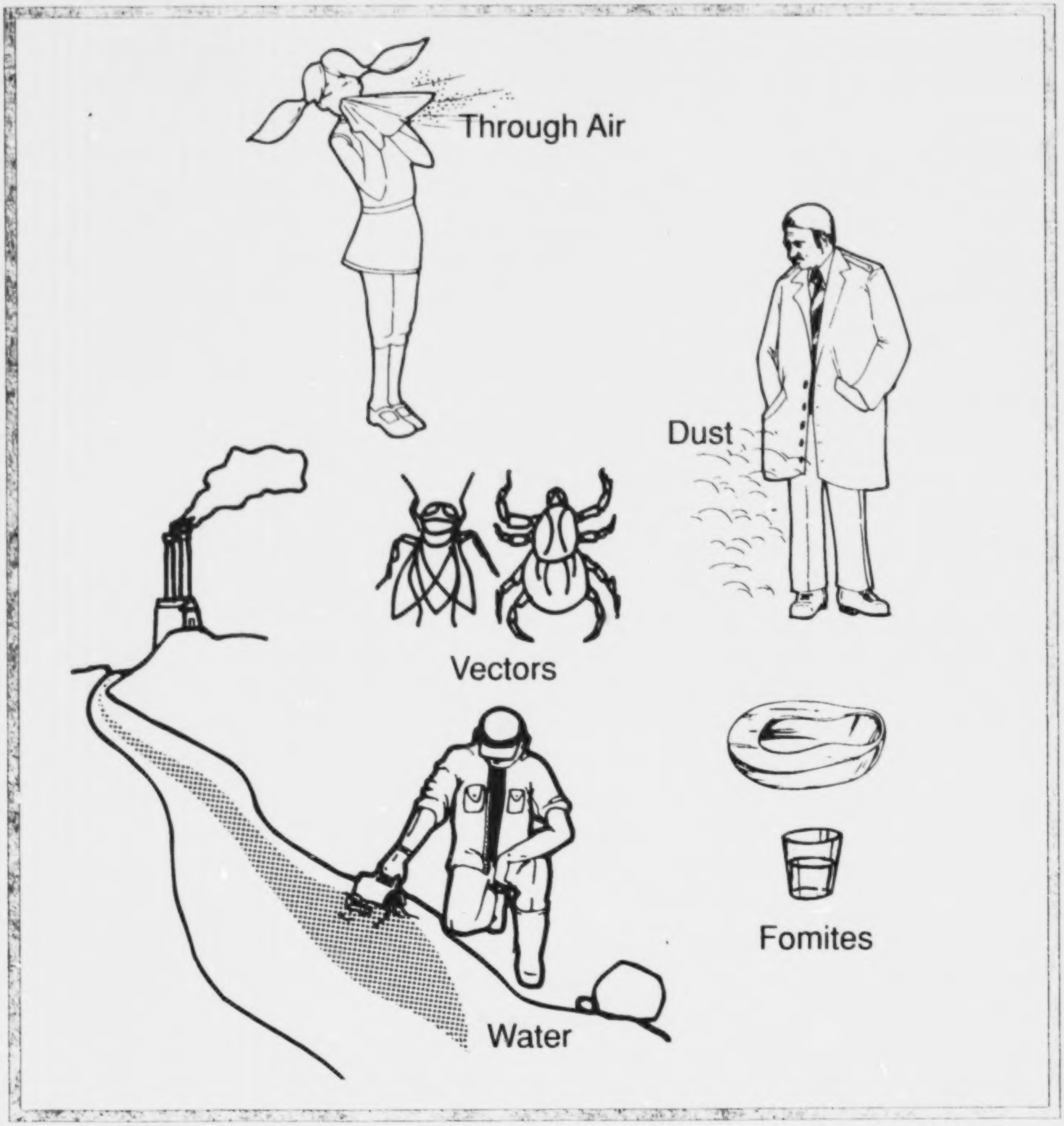




45 people ill with vomiting and diarrhea by evening

# Indirect Contact

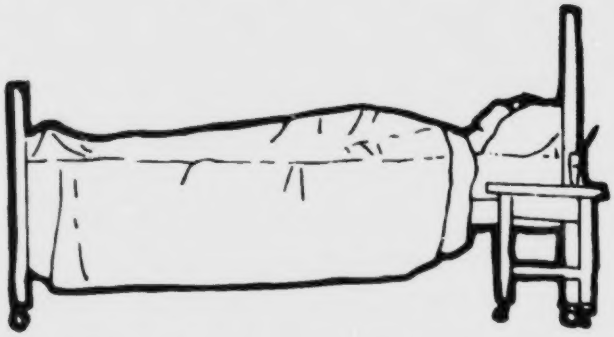
## (Through Other Media)


Through Air
Dust
Vectors
Fomites
Water

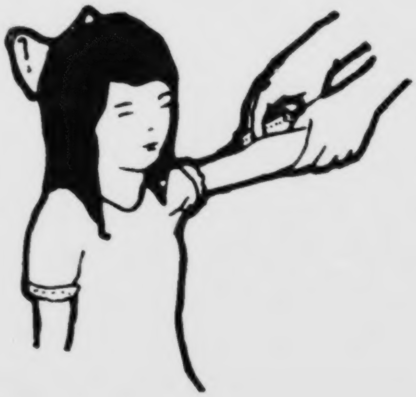
# Types of Immunity

- Acquired Immunity
  - Active
    - Naturally acquired active immunity
    - Artificially acquired active immunity
  - Passive
    - Naturally acquired passive immunity
    - Artificially acquired passive immunity

# Active Immunity

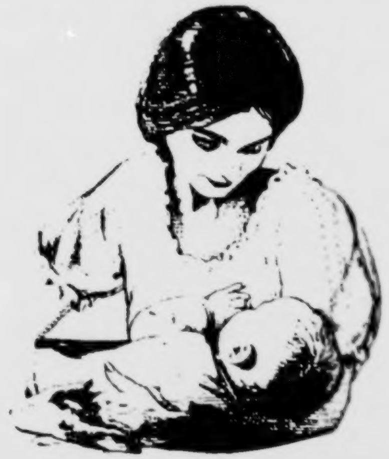


**Naturally Acquired Active Immunity**—Person contracts disease; manufactures antibodies. Immunity is long-term.

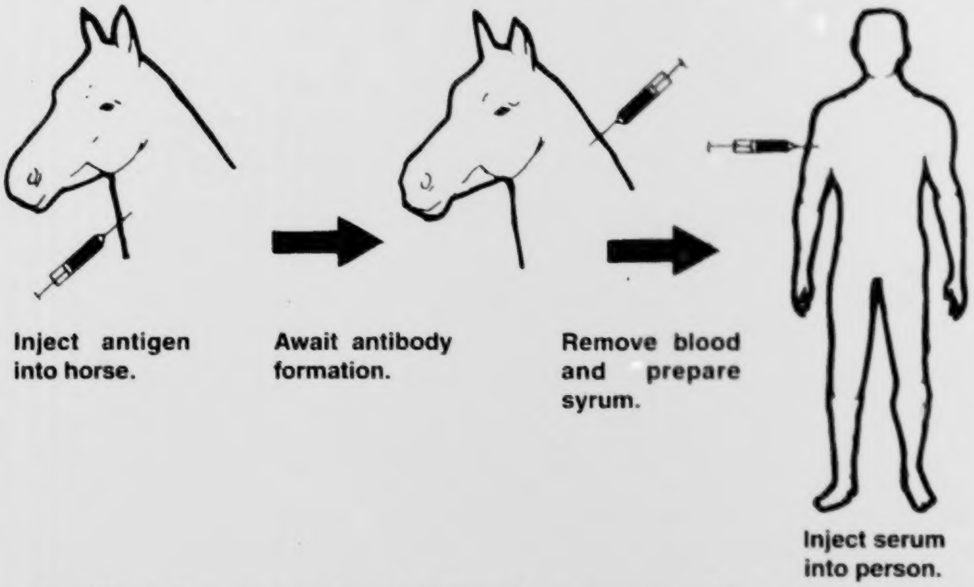


**Artificially Acquired Active Immunity**—Person is vaccinated; produced own antibodies. Immunity lasts for months or years.

# Passive Immunity



**Naturally Acquired Passive Immunity**—Mother's antibodies passed to infant. Immunity is short-term.


Inject antigen into horse.
Await antibody formation.
Remove blood and prepare syrum.
Inject serum into person.

**Artificially Acquired Passive Immunity**—Immune serums containing antibodies are injected. Immunity is immediate, but short-term.

## Written Test

Name ______________________________

Date ____________________ Score ____________________

**Objective 1** Define the term *infection*. Write your answer on the blank lines provided below.

**Infection**—______________________________

______________________________

______________________________

______________________________

**Objective 2** Select true statements concerning human portals of entry by placing an "X" next to the true statements.

_____ a. A pregnant female infected with HIV can transmit the microorganism through the placenta to the fetus.

_____ b. Hepatitis B, HIV, yellow fever, and malaria use the alimentary tract as the portal of entry.

_____ c. Sexually transmitted diseases use the respiratory tract as the portal of entry.

_____ d. The skin must be broken to act as a portal of entry.

_____ e. Pneumonia, measles, tuberculosis, and the common cold usually enter the respiratory tract.

_____ f. A portal of entry may be a natural opening, such as the mouth.

**Objective 3** List five human portals of exit.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

**OBJECTIVE 4** Select factors influencing the occurrence of infection by placing an "X" in the appropriate blanks.

_____ a. Layout of the operating room

_____ b. Portal of entry

_____ c. Resistance of host

_____ d. Number of organisms

_____ e. Size of organisms

_____ f. Virulence of the organism

**OBJECTIVE 5** Match types of infections on the right to their correct descriptions.

_______ a. Infection that is caused by more than one organism

_______ b. Infection that follows or complicates the original disease; a subsequent infection or complication to an existing condition

_______ c. Infection that runs a rapid and severe course terminating abruptly

_______ d. Infection that is inactive or hidden; no apparent symptoms

_______ e. First or original infection; first occurring infection within a period of illness

_______ f. Infection that involves only one organ or site of a host's body

_______ g. Infection that is contracted in a hospital or other health-care facility, such as a nursing home

_______ h. Infection that runs a slow course over a long period of time; may last from weeks to years

_______ i. Infection that has spread throughout a host's body from an initial site

1. Acute infection
2. Chronic infection
3. Latent infection
4. Localized infection
5. Mixed infection
6. Nosocomial infection
7. Primary infection
8. Secondary infection
9. Systemic infection

**OBJECTIVE 6** Match the stages of an acute infection on the right to their correct descriptions.

______ a. Begins with decline of fever and acute symptoms; length of time depends upon the severity of the acute stage, treatment, and general health of the patient

______ b. Short period, usually a day or less, when the infection has been established but symptoms are not fully developed; the host may not feel well, but symptoms are vague

______ c. Period of actual illness with symptoms, degree of fever, and length of time depending upon the disease, condition of patient, and treatment

______ d. Period of time between entrance of organisms to the body and onset of symptoms in a host

1. Acute
2. Convalescent
3. Incubation
4. Prodromal

**OBJECTIVE 7** Distinguish between direct and indirect contact in the transmission of pathogens by placing an "X" next to the descriptions of indirect contact.

_____ a. Denotes the spread of contagious disease by some medium other than directly touching an infected person

_____ b. Transmission of a contagious disease by a healthy person coming in contact with a person who is a carrier of or has the disease

_____ c. Media include fomites and vectors

_____ d. Media include dirt and air molecules

**OBJECTIVE 8** Describe three means of controlling the transmission of infections for each category.

a. Portal of entry

1) ______________________________

2) ______________________________

3) ______________________________

b. Portal of exit

1) ______________________________

2) ______________________________

3) ______________________________

c. Vectors or carriers of infection

1) ______________________________

2) ______________________________

3) ______________________________

**OBJECTIVE 9**

Complete the following statements concerning the effects of infection on a human host. Write your answers on the blank lines provided in the statements below.

a. The harmful effects of an infection on a host may be the direct result of an ________________ taken by a pathogen or the result of ________________ produced by the pathogen.

b. An infecting organism generally causes ________________ by disrupting normal activities of a host's cells.

c. The infecting organism's ____________________ depends on how the organism enters the body and the number of invading pathogens.

d. An infection may result in observable ________________________ or occur without ________________________.

e. The period of time between the incidence of infection and the appearance of symptoms in a host is referred to as the ________________________ period.

f. An infection in a host may be ____________________, limited to only one organ or site, or it may be ____________________, affecting the entire body.

g. The host's body produces ______________________ in response to the presence of an antigen. These ______________________ recognize pathogens and destroy them.

h. ______________________ diseases are infections that can be spread from one host to another through direct or indirect contact.

i. The ability of a host to avoid infection and reduce harm caused by an infecting organism is called ___________________________.

**OBJECTIVE 10**

List the factors that contribute to the spread of nosocomial infections. Write your answers on the blank lines provided below.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

d. ____________________________________________

e. ____________________________________________

**Objective 11** Match organisms that cause common nosocomial infections on the right to the infections they cause.

_______ a. Involved in "strep" throat, scarlet fever, pneumonia, rheumatic heart disease, and other communicable conditions

_______ b. Responsible for various infections referred to as *colitis*

_______ c. Presents a particular hazard for various infections to burn victims, patients with cystic fibrosis, and those patients with certain types of cancer where the skin and mucous membranes do not afford adequate protection

_______ d. Responsible for AIDS

_______ e. Associated with several types of cancer, including cancers of the mouth and cervix

_______ f. Responsible for tuberculosis and leprosy and present a particular hazard for various infections to patients with low resistance, such as those with acquired immunodeficiency syndrome (AIDS), to those receiving immunosuppressors, and to those with pulmonary conditions

_______ g. Responsible for hepatitis

_______ h Responsible for a number of postoperative infections commonly referred to as *staph infections*

1. Esherichia coli
2. Hepatitis B virus
3. Human immunodeficiency virus (HIV)
4. Human papilloma virus
5. Mycobacterium species
6. Pseudomonas aeruginosa
7. Staphylococcus aureus
8. Streptococcus species

**Objective 12** List the factors that influence the virulence of a pathogen in a host's body. Write your answers on the blank lines provided below.

a. ________________________________________

b. ________________________________________

c. ________________________________________

d. ________________________________________

**Objective 13** Complete the following statements concerning the body's defenses against diseases by circling the correct answers.

a. **(Antibodies, Physical barriers)** are the body's first line of defense to prevent invasion of many pathogens.

b. Trauma can induce an **(immune, inflammatory)** response.

c. The immune response leads to the production of **(white, red)** blood cells.

d. The inflammatory response depends on **(white, red)** blood cells that begin phagocytosis.

e. Barriers to disease include tears, saliva, and **(blood, skin)**.

**OBJECTIVE 14** Select from the following list the correct purposes of inflammation by placing an "X" in the appropriate blanks.

_____ a. To produce energy sources

_____ b. To produce antibiotics

_____ c. To produce antibodies

_____ d. To prevent spread of pathogens

_____ e. To destroy pathogens

_____ f. To strengthen the virulence of pathogens

_____ g. To heal and repair damaged tissue

_____ h. To localize infection

**OBJECTIVE 15** List four of the symptoms of acute inflammatory response. Write your answers on the blank lines provided below.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

**OBJECTIVE 16** Select the true statements concerning the treatment of acute inflammation by placing an "X" next to the true statements.

_____ a. Exercise for the inflamed part

_____ b. Application of ice to constrict blood vessels and decrease flow of blood and its white cells and antibodies to the affected part

_____ c. Open drainage to allow bacteria to escape and to relieve tension and swelling of inflamed part

_____ d. Supplement body's natural defenses with specific drugs such as antibiotics

**OBJECTIVE 17** Define the term *immunology*. Write your answer on the blank lines provided below.

**Immunology**— ____________________

____________________

**OBJECTIVE 18**

Distinguish between types of immune responses by placing an "X" next to the description(s) of humoral immune response.

_____ a. Involves the production of B cells and some T cells in response to exposure to an antigen and the B cells then produce antibodies.

_____ b. Involves the production of T cells (no B cells or antibodies)

**OBJECTIVE 19**

Distinguish between a T cell and a B cell by placing an "X" next to the description(s) of a T cell.

_____ a. Type of lymphocyte that is formed in fetal bone marrow and moves directly to the lymph nodes and spleen

_____ b. Type of lymphocyte that is formed either in the fetal thymus gland or in the bone marrow and passes through the thymus on its way to the lymph nodes and spleen

**OBJECTIVE 20**

Match types of T cells and B cells on the right to their correct functions.

_______ a. Carry the imprint of a particular pathogen's antigens and store the imprint in preparation for future invasions of the pathogen

_______ b. Suppress the immune response once a foreign antigen has been destroyed

_______ c. Seek out phagocytes that have engulfed pathogens and examine the antigens of captured pathogens; may also present the foreign antigen to B cells

_______ d. Produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes

_______ e. Chemically rupture the cell membrane of infected cells to prevent the pathogen from reproducing and also produce chemicals that attract phagocytes to the area where the pathogen is located

_______ f. Divide rapidly to produce memory, cytotoxic, and suppressor T cells

_______ g. Remember the antigen and will become involved in responding to any subsequent invasion by that pathogen

_______ h. Divide into memory B cells and plasma cells

_______ i. Reside in the liver, spleen, and lymph nodes until exposed to the antigen of their target pathogen

1. Activated B cells
2. Cytotoxic T cells
3. Helper T cells
4. Inactive B cells
5. Memory B cells
6. Memory T cells
7. Plasma cells
8. Sensitized helper T cells
9. Suppressor T cells

## Module 2-C: Infection and Immunology

**OBJECTIVE 21**

Describe the types of cellular and tissue defense-mechanism processes the body uses against disease and infection. Write your answers on the blank lines provided below.

a. Interferon response— ______________________________

______________________________________________

______________________________________________

b. Phagocytosis— ______________________________

______________________________________________

______________________________________________

c. Serum-protein response— ______________________________

______________________________________________

______________________________________________

d. Inflammatory reaction— ______________________________

______________________________________________

______________________________________________

**OBJECTIVE 22**

Describe the phases of the antibody-production cycle that follows the body's exposure to an antigen. Write your answers on the blank lines provided below.

a. Lag phase— ______________________________

______________________________________________

______________________________________________

______________________________________________

b. Primary-response phase— ______________________________

______________________________________________

______________________________________________

______________________________________________

c. Secondary-response phase— ______________________________

______________________________________________

______________________________________________

______________________________________________

**OBJECTIVE 23** Match types of white blood cells on the right to their correct descriptions.

_______ a. One of two types of white blood cells—a T cell or a B cell—that performs various functions related to recognizing, marking, and remembering pathogens based on their antigens

_______ b. A type of white blood cell that is the first to respond to an inflammatory reaction, where it performs phagocytosis on pathogens

_______ c. A type of white blood cell that is believed to neutralize toxins such as those secreted by some pathogens

_______ d. A type of white blood cell that, as part of the inflammatory reaction, releases chemicals that allow the capillaries to be penetrated by white blood cells and other substances that accumulate at an infection site

_______ e. A type of white blood cell that enlarges to form a macrophage in order to perform more-rapid phagocytosis

1. Basophil
2. Eosinophil
3. Lymphocyte
4. Monocyte
5. Neutrophil

**OBJECTIVE 24** Select the true statements concerning the types of immunity by placing an "X" next to the true statements.

_____ a. Acquired immunity is programmed into one's genetic makeup.

_____ b. Genetic immunity does not involve antibodies.

_____ c. Genetic immunity varies between individuals, nationalities, racial groups, and species.

_____ d. Acquired immunity is always artificially acquired.

**OBJECTIVE 25** Match types of acquired immunity on the right to their correct descriptions.

_______ a. Individual is administered a vaccine; body then produces antibodies to the antigen.

_______ b. Individual contracts disease, and then produces own antibodies to that specific disease and long term memory cells to that disease (antigen).

_______ c. Mother's antibodies pass through placenta to fetus or through breast milk to infant.

_______ d. Antibodies produced elsewhere are injected in the form of immune serums.

1. Artificially acquired active immunity
2. Artificially acquired passive immunity
3. Naturally acquired active immunity
4. Naturally acquired passive immunity

**Objective 26**

List three types of vaccines.

a. ____________________

b. ____________________

c. ____________________

**Objective 27**

Complete the following statements concerning the allergic response. Write your answers on the blank lines provided in the statements below.

a. Is basically an ______________ reaction

b. Is brought on by ______________ which cause altered reactions in the body tissue of sensitized individuals but which produce no effect in nonsensitized individuals

c. Does not occur on ______________ contact with potential allergen because antibodies have not yet been produced

d. An example of an allergic reaction is ______________.

e. Treatment may include avoiding the allergen, desensitization, or use of ______________.

f. A common inhalant allergen is ______________.

g. A common food allergen is ______________.

h. A common drug allergen is to ______________.

i. A common contactant allergen is ______________.

**Objective 28**

Complete the following statements concerning the characteristics of anaphylaxis by circling the correct answers.

a. Anaphylaxis is a **(mild, severe)** allergic reaction to a drug or foreign protein.

b. Hypersensitive body cells reacting to the drug release histamine or a histamine-like substance, causing vasodilation, hypotension, and **(cardiac, bronchiolar)** constriction.

c. Reactions which constitute anaphylactic shock include irritability, **(dyspnea, hyperpnea)**, cyaosis, unconsciousness, and possible convulsions.

d. Anaphylactic reactions occur within **(minutes, hours, days)**.

e. Treatment includes **(antibiotics, epinephrine)**.

f. Serum sickness is an anaphylactic reaction which occasionally follows injection of a **(vaccine, serum)**.

**OBJECTIVE 29**

Select the true statements concerning the rejection syndrome by placing an "X" next to the true statements.

_____ a. Is a type of antigen—antibody reaction

_____ b. Never occurs following transplantation of an organ or tissue

_____ c. Every organism has a natural tendency to reject foreign substances, especially tissues from another person or animal.

_____ d. Tissues or organs to be transplanted are cross-matched in much the same way that blood is matched for transfusion, but matching tissues is more complex than matching blood types.

_____ e. Drugs that suppress antibody formation are used to decrease tissue rejection.

***Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1** An invasion of the body by organisms and the reaction of the body to the presence of those organisms and to the toxins they produce; the presence of and multiplication of an organism that results in harm or disease to a host

**OBJECTIVE 2** a, d, e, f

**OBJECTIVE 3** Any five of the following. Answers may appear in any order.

a. Blood
b. Fecal matter (feces)
c. Urine
d. Respiratory secretions
e. Saliva
f. Tears
g. Semen and vaginal secretions
h. Other body fluids that may contain infectious blood cells including cerebrospinal fluid, synovial fluid, pericardial fluid, peritoneal fluid, amniotic fluid, breast milk, and vomit

**OBJECTIVE 4** b, c, d, f

**OBJECTIVE 5**

a. 5
b. 8
c. 1
d. 3
e. 7
f. 4
g. 6
h. 2
i. 9

**OBJECTIVE 6**

a. 2
b. 4
c. 1
d. 3

**OBJECTIVE 7** a, c, d

**OBJECTIVE 8**

Any three of the following for each category:

a. Portal of entry

1) Wash hands.
2) Place sterile bandages over wounds.
3) Wear masks over nose and mouth.
4) Wear protective eyewear/face shields in case of splashing.
5) Use insect repellent.
6) Do not eat or drink contaminated food or beverages.
7) Properly clean after urination and defecation.
8) Have required vaccinations.
9) Use only sterile supplies for invasive procedures (injections, etc.).
10) Cleanse the proposed incision site.
11) Provide a sterile environment and supplies in surgery.

b. Portal of exit

1) Bandage draining sores or wounds.
2) Wear gloves and change after contamination. Also wash hands after removing gloves.
3) Wear masks over nose and mouth.
4) Wear protective eyewear/face shields.
5) Wear protective aprons/gowns (impermeable clothing).
6) Properly handle/dispose of contaminated articles such as instruments, linens, etc. and medical waste products.
7) Properly handle/dispose of sharps (needles, blades).
8) Use "no touch" passing of sharp instruments and blades.
9) Decontaminate all surfaces and devices after use.

c. Vectors or carriers of infection

1) Sterilize or disinfect fomites.
2) Disinfect air.
3) Use dust control measures.
4) Properly handle food, water, and milk.
5) Control insects.
6) Vaccinate household pets for rabies.

**OBJECTIVE 9**

a. action; toxins
b. illness
c. virulence
d. symptoms; symptoms
e. incubation
f. localized; systemic
g. antibodies; antibodies
h. Communicable
i. resistance

**OBJECTIVE 10**

Answers may appear in any order.

a. Improper hand-washing techniques
b. Inappropriate use of antibiotics
c. Surgical procedure
d. Specimen and tissue handling
e. Administration of immunosuppressive agents

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**OBJECTIVE 11**

a. 8
b. 1
c. 6
d. 3
e. 4
f. 5
g. 2
h. 7

**OBJECTIVE 12**

Answers may appear in any order.

a. Overall health of the host
b. Number of organisms that are able to invade the host
c. Strength of toxins produced by the organism
d. Amount of toxins produced by the organism

**OBJECTIVE 13**

a. Physical barriers
b. inflammatory
c. white
d. white
e. skin

**OBJECTIVE 14**

d, e, g, h

**OBJECTIVE 15**

Any four of the following. Answers may appear in any order.

a. Redness
b. Heat
c. Swelling
d. Pain
e. Disordered (impaired) function

**OBJECTIVE 16**

c, d

**OBJECTIVE 17**

The study of the ways in which the body resists infection

**OBJECTIVE 18**

a

**OBJECTIVE 19**

b

**OBJECTIVE 20**

a. 6
b. 9
c. 3
d. 7
e. 2
f. 8
g. 5
h. 1
i. 4

## Module 2-C: Infection and Immunology

**OBJECTIVE 21**

a. The process by which a cell releases chemicals that interfere with a virus' ability to reproduce within a cell
b. The process in which a moving cell engulfs a mass of foreign material
c. The process by which components of the blood and lymph analyze captured pathogens to help develop immunity reactions to the pathogens
d. The process by which tissues in an area of injury or infection work to trap pathogens in the area

**OBJECTIVE 22**

a. The phase during which the body detects an unrecognized foreign antigen and begins to react
b. The phase during which the body produces (1) antibodies that "fit" the previously unrecognized antigen and (2) memory cells that will recognize that antigen during any subsequent exposure
c. The phase during which the body is exposed to a subsequent invasion by an antigen, the memory cells immediately recognize the antigen, and the body produces antibodies against it

**OBJECTIVE 23**

a. 3
b. 5
c. 2
d. 1
e. 4

**OBJECTIVE 24**

b, c

**OBJECTIVE 25**

a. 1
b. 3
c. 4
d. 2

**OBJECTIVE 26**

Any three of the following. Answers may appear in any order.

a. Living attenuated pathogens
b. Killed (inactivated) pathogens
c. Toxoids
d. Extracts of pathogens

**OBJECTIVE 27**

a. antigen-antibody
b. allergens
c. first
d. One of the following: itching, redness of skin, headache, breathing difficulties, or anaphylaxis
e. antihistamines
f. One of the following: dust, pollen, or perfume
g. One of the following: wheat, eggs, milk, chocolate, or strawberries
h. One of the following: aspirin, various antibiotics, or serums
i. One of the following: animals, plants, hair, and fur

Note: Students may give different answers for d, e, f, g, h, and i, which may be correct if they could be considered "common." Evaluate them on an individual basis.

**OBJECTIVE 28**

a. severe
b. bronchiolar
c. dyspnea
d. minutes
e. epinephrine
f. serum

## Answers to Assignment Sheets

### Assignment Sheet 1

| Portal of Entry | Portal of Exit |
|---|---|
| 1. Broken skin | Blood and body fluids from infected wound |
| 2. Respiratory tract | Saliva and respiratory secretions (sputum) |
| 3. Alimentary tract | Fecal matter |
| 4. Through genitourinary tract (sexual contact), through broken skin to circulatory system, or directly to circulatory system through contaminated blood, body fluids, or instruments | Blood and body fluids |
| 5. Genitourinary tract or placenta | Semen and vaginal secretions |
| 6. Respiratory tract or placenta | Respiratory secretions or blood or body fluids from draining lesions |
| 7. Alimentary tract | Fecal matter |
| 8. Broken skin (usually must be deep wound) | Blood and body fluids from infected wound |
| 9. Through genitourinary tract (sexual contact), through placenta, through broken skin to circulatory system, or directly to circulatory system through contaminated blood, body fluids, or instruments. | Blood and body fluids, including semen and vaginal secretions |
| 10. Respiratory tract | Respiratory secretions |

### Assignment Sheet 2

Answers will vary and must be evaluated to the satisfaction of the instructor.

### Assignment Sheet 3

Answers will vary and must be evaluated to the satisfaction of the instructor.

## Module Review

Name ______________________________________________

Date ______________________ Score ______________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 25

1. In which type of immunity is an individual administered a vaccine and the body then produces antibodies to the antigen that may or may not last a lifetime?
   a. artificially acquired natural immunity
   b. naturally acquired active immunity
   c. artificially acquired active immunity
   d. naturally acquired passive immunity

Objective 8

2. The transmission of microorganisms from person to person or from object to person is called ____________________.
   a. asepsis
   b. carrier
   c. contamination
   d. decontamination

Objective 17

3. The study of the ways in which the body resists infection is called ____________.
   a. epidemiology
   b. immunology
   c. histology
   d. virology

Objective 1

4. An invasion of the body by organisms and the reaction of the body to the presence of those organisms and to the toxins they produce is called ______________:
   a. antibodies
   b. droplet nuclei
   c. infection
   d. portal of entry

Objective 8

5. The guidelines that are recommended by the Centers for Disease Control to prevent the transmission of bloodborne pathogens are known as ____________________.

a. bloodborne pathogen asepsis

b. infection control

c. medical asepsis

d. Standard Precautions

Objective 14

6. Which of the following is NOT a purpose of the inflammatory response?

a. to destroy pathogens

b. to heal and repair damaged tissue

c. to maintain homeostasis

d. to localize infection

Objective 2

7. A specific pathway by which microorganisms enter the body that result in infection are known as ____________________.

a. contamination

b. infection pathway

c. portal of entry

d. portal of exit

Objective 24

8. What type of immunity does not involve antibodies, is programmed into one's genetic make-up, and varies between individuals?

a. active

b. acquired

c. genetic

d. passive

Objective 4

9. Which of the following factors is true concerning the ability of a malarial organism to cause an infection when it has entered through the alimentary tract?

a. resistance determines whether or not an infection will take place

b. organisms must enter in a specific pathway to cause infection

c. organisms are more virulent if they produce hemolysis

d. all organisms cause infection

Objective 6

10. What is the stage of acute infection that involves a short period, usually a day or less, when symptoms are vague?

    a. acute

    b. convalescent

    c. incubation

    d. prodromal

Objective 13

11. The type of white blood cells including T-cells and B-cells that assist in immunity are ____________.

    a. lymphocytes

    b. macrophage

    c. monocyte

    d. serocyte

Objective 27

12. Which of the following are common allergens?

    a. dust, pollen, aspirin

    b. animals, perfume, eggs

    c. milk, strawberries, fur, plants

    d. all of the above

Objective 7

13. Patient to patient or patient to worker are examples of which type of pathogen transmission?

    a. direct contact

    b. indirect contact

    c. vector contact

    d. fomite contact

Objective 9

14. The infection effects on a host are dependent on the microorganisms' virulence, portal of organism entry, and the ____________________.

    a. toxins produced by the organism

    b. host's antibodies

    c. number of invading pathogens

    d. host's antigen response

Objective 5

15. A __________________ infection involves only one organ or site of a host's body.

a. localized

b. mixed

c. primary

d. systemic

Objective 10

16. Which of the following factors contribute to the development of nosocomial infections in patients that have had tissue or organ transplants?

a. improper hand-washing techniques

b. administration of immunosuppressive agents

c. excessive use of antibiotics

d. improper specimen or tissue handling

Objective 11

17. What organism is responsible for a number of post-operative infections?

a. esherichia coli

b. pseudomonas aeruginosa

c. staphylococcus aureus

d. streptococcus

Objective 11

18. What organism is responsible for TB and leprosy and presents a particular hazard for various infections to patients with low resistance, such as those with acquired immunodeficiency syndrome, to those receiving immunosuppressors, and to those with pulmonary conditions?

a. human papilloma

b. mycobacterium

c. staphylococcus aureus

d. streptococcus

Objective 4

19. Whether or not an infection will take place and the severity of the disease is determined by the ________________________________.

a. chemical barriers

b. local tissue reaction

c. resistance of the host

d. type of organism

Objective 12

20. Which of the following is NOT a factor that influences the virulence of pathogens?

a. overall health of the host
b. incubation period of the organism
c. number of organisms that are able to invade the host
d. amount of toxins produced by the organism

Objective 23

21. A type of white blood cell that, as a part of the inflammatory reaction, releases chemicals that allow the capillaries to be penetrated by white blood cells and other substances that accumulate at an infection site is called a ______________.

a. basophil
b. eosinophil
c. lymphocyte
d. neutrophil

Objective 13

22. Local tissue reaction to cell injuries such as foreign bodies, chemicals, microorganisms, or trauma represents which type of body defense?

a. physical and chemical barrier
b. inflammatory response
c. immune response
d. auto-immune response

Objective 15

23. Which of the following is NOT a symptom of acute inflammatory response?

a. impaired function, pain
b. redness, drainage
c. heat, disordered function
d. swelling, pain

Objective 20

24. Which cells produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes?

a. cytotoxic T cells
b. inactivated B cells
c. memory T cells
d. plasma cells

Objective 16

25. Applying moderate heat to dilate blood vessels and increasing the flow of blood and its white cells and antibodies to the affected part is the treatment for which of the following?

a. infection
b. inflammation
c. immune response
d. antibody reactions

Objective 10

26. Which of the following factors contribute to the development of nosocomial infections by allowing pathogens to become resistant to the effects of certain medications and by destroying normal resident flora allowing other organisms to gain a competitive advantage?

a. surgical procedure
b. improper hand-washing technique
c. inappropriate use of antibiotics
d. improper tissue and specimen

Objective 23

27. A type of white blood cell that is believed to neutralize toxins such as those secreted by some pathogens is called a(n) ________________________.

a. basophil
b. eosinophil
c. lymphocyte
d. monocyte

Objective 13

28. Which of the following is a protein substance developed by the body in response to the presence of an antigen that counteracts the antigen?

a. allergen
b. antibody
c. endotoxin
d. immune response

Objective 21

29. The process by which a moving cell engulfs a mass of foreign material is called ________________________.

a. active immunity
b. interferon
c. serum-protein response
d. phagocytosis

Objective 5

30. An infection that follows or complicates the original disease or is a complication to an existing condition is known as a(n) ____________________ infection.

a. acute
b. chronic
c. latent
d. secondary

Objective 23

31. What type of white blood cells make up approximately 55 to 70 percent of the white blood cells, provide a quick response that is not as organized and specific as subsequent reactions, and charge into the infected site and begin attacking foreign materials?

a. basophils
b. monocytes
c. lymphocytes
d. neutrophils

Objective 6

32. The period of time between the entrance of an organism to the body and the onset of symptoms is called ________________________.

a. acute
b. convalescent
c. incubation
d. prodromal

Objective 8

33. Which of the following is NOT a method of controlling the transmission of infections?

a. use "no-touch" technique of sharp instruments and blades
b. use PPE when handling blood or blood contaminated items
c. control insects
d. reduce aseptic technique practices

Objective 22

34. In which phase does the body detect an unrecognized foreign antigen and begin to react?

a. lag
b. memory
c. primary response
d. secondary response

Objective 26

35. Vaccines for rabies, influenza, pertussis and typhoid fever are examples of which type of vaccines?

   a. live weakened or less virulent pathogens

   b. killed or inactivated pathogens

   c. contain extracts of pathogens

   d. contains toxins of the pathogen

Objective 18

36. What type of immune response involves the production of T cells in response to exposure to an antigen and is a delayed response that is important in tissue transplant rejection?

   a. inflammatory

   b. cell-mediated

   c. delayed

   d. humoral

Objective 24

37. What type of immunity involves the use of antibodies, may be naturally acquired or artificially acquired, and may be active or passive?

   a. active immunity

   b. naturally acquired immunity

   c. positive immunity

   d. acquired immunity

Objective 19

38. What type of lymphocyte is formed in the fetal thymus gland or in the bone marrow and passes through the thymus on its way to the lymph nodes and spleen?

   a. interferon

   b. helper T cell

   c. T cell

   d. B cell

Objective 25

39. Immune serums prepared in animals or other humans or in the laboratory to provide short-term immunity with no memory against future invasions are called ______________________________.

   a. artificially acquired active immunity

   b. naturally acquired active immunity

   c. artificially acquired passive immunity

   d. naturally acquired passive immunity

Objective 8

40. Which of the following is NOT a transmission control method of portals of entry?

    a. cleanse incision sites
    b. control insects
    c. wash hands
    d. vaccinations

Objective 20

41. Which type of cells reside in the liver, spleen, and lymph nodes until exposed to the antigen of their target pathogen?

    a. suppressor T cells
    b. plasma cells
    c. activated B cells
    d. inactive B cells

Objective 7

42. Rocky Mountain spotted fever is transmitted by ____________________ contact.

    a. direct
    b. indirect
    c. fomite
    d. vector

Objective 2

43. Microorganisms that can be transmitted by contaminated blood transfusions and needle sticks enter through the ______________________________.

    a. alimentary tract
    b. circulatory system
    c. genitourinary tract
    d. respiratory system

Objective 18

44. What type of immune response involves the production of B cells and some T cells in response to exposure to an antigen?

    a. allergen
    b. antibody
    c. humoral
    d. serum

Objective 3

45. Blood that is transferred from an open wound or by infected needles or instruments are examples of which of the following?

    a. droplet nuclei

    b. portals of exit

    c. transmission techniques

    d. vectors

Objective 28

46. A severe allergic reaction to a drug such as penicillin or a foreign protein such as insect venom is called __________________________.

    a. allergen

    b. anaphylaxis

    c. interferon

    d. phagocytosis

Objective 21

47. The process by which a cell releases chemicals that interfere with a virus' ability to reproduce within a cell is called ______________________.

    a. inflammatory reaction

    b. interferon response

    c. serum-protein response

    d. phagocytosis

Objective 22

48. In which of the following phases does the body produce antibodies that fit the previously unrecognized antigen and produce the memory cells that will recognize that antigen during any subsequent exposure?

    a. lag phase

    b. memory phase

    c. primary response phase

    d. secondary response phase

Objective 28

49. Death usually results from a severe anaphylactic reaction due to __________________.

    a. hypersensitive body cells

    b. antigen-antibody reaction

    c. spasm of the bronchiole muscles

    d. serum thickness

Objective 29

50. Which of the following statements is FALSE regarding rejection syndrome?

    a. every organism has a natural tendency to reject foreign substances

    b. always occurs following transplantation of an organ or tissue as well as with metal implant placement

    c. drugs are used to suppress antibody formation to decrease tissue rejection

    d. tissues or organs to be transplanted are cross matched before transplantation

Objective 27

51. If an individual does not experience an allergic response when exposed to a potential allergen but subsequent exposure result in an allergic response, what has happened?

    a. enough antibodies have now been produced to trigger the allergic response

    b. there is not enough toxins to produce a reaction

    c. vaccines prohibit a reaction

    d. naturally acquired passive immunity takes over the body's defenses

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. c
2. c
3. b
4. c
5. d
6. c
7. c
8. c
9. b
10. d
11. a
12. d
13. a
14. c
15. a
16. b
17. c
18. b
19. c
20. b
21. a
22. b
23. b
24. d
25. b
26. c
27. b
28. b
29. d
30. d
31. d
32. c
33. d
34. a
35. b
36. b
37. d
38. c
39. c
40. b
41. d
42. d
43. b
44. c
45. b
46. b
47. b
48. c
49. c
50. b
51. a

# Introduction to Surgical Technology

## SECTION C:
## Microbiology

### Module 3-C: Wound Healing

## Module Contents

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# Introduction to Surgical Technology
## Section C: Microbiology
## Module 3-C: Wound Healing

## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Suggested Supplemental Resources," "Resources Used in Developing This Module," and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.

- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to teach students about the wound-healing processes in the human body.

- Divide the class into groups and assign each a type of traumatic wound and have them discuss examples of their assigned type. Each group should present their examples to the class.
- Divide the class into four groups. Assign each group one of the classifications of surgical wounds. Pass out a list of surgical procedures and have each group decide which procedures fit into their assigned classification. They should be ready to explain their decisions. Have each group report their decisions and rationale.
- You may want to correlate this module with first aid and teach basic first aid techniques at this time. Contact your local Red Cross for assistance.
- Provide illustrations of types of tissue injuries and types of traumatic wounds. Visit a care facility to observe these types of injuries if appropriate for your program and students. Discuss the potential severity and treatment for these types of injuries and traumatic wounds, especially where surgery may be required.
- Provide the students with illustrations of the stages of healing. Discuss each stage: what is happening in the body as a result of the healing process.
- Concerning the levels of intention as they relate to healing, help the students to understand that these levels of treatment may be unavoidable. For example, if an injury requiring sutures cannot receive immediate medical attention, the healing process will begin without the assistance that surgical intervention can provide. After a certain point, the level of treatment must be assessed in terms of the healing that has taken place—that is, if suturing is eventually available will the healing be enhanced or harmfully interrupted by surgical intervention. Also discuss medically maintained openings such as tracheotomies, colostomies, and iliostomies.
- Use case studies of actual patient histories to supplement your discussion of the wound-healing process and the factors that present possible complications to the wound-healing process.
- Objective 7 provides statistical information about classes of surgical wounds. Modify the material as necessary to be consistent with the terminology and criteria used in your local facilities. Discuss expected infection rates and reasons for the increased risk with higher classifications of surgical wounds. Discuss reasons that may necessitate performing procedures under less-than-ideal conditions. Provide illustrations of the various classes of surgical wounds.

**RESOURCES USED THIS MODULE**

- American Red Cross. *American Red Cross Community First Aid and Safety*, 1993.
- *Anatomy & Physiology*. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium, Inc., 2001.
- *Core Curriculum for Surgical Technology*. 5th ed. Centennial, CO: Association of Surgical Technologists, 2002.
- Fortunato, Nancymarie. *Berry and Kohn's Operating Room Technique*. 9th ed. St. Louis: Mosby, Inc., 2000.
- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Rothrock, Jane C. *Alexander's Care of the Patient in Surgery*. 12th ed. St. Louis: Mosby, Inc., 2003.
- Sherris, David A., and Eugene B. Kern. *Basic Surgical Skills*. Rochester, MN: Mayo Foundation for Medical Education and Research, 1999.

**SUGGESTED SUPPLEMENTAL RESOURCES**

- Contact Davis & Geck, Pearl River, NY 10965 for videos or printed material on wound healing, or check with their local sales representative.
- Contact Ethicon, Inc. Somerville, NJ 08876 for videos or printed materials on wound healing, or check with their local sales representative, or visit www.ethicon.com.

**Multimedia**

- The following companies offers a multitude of health-related videos and CD-ROMs.

AIMS Multimedia
9710 DeSoto Avenue
Chatsworth, CA 91311-4409
800-367-2467
www.aimsmultimedia.com

Medcom, Inc.
6060 Phyllis Drive
Cypress, CA 90630
800-877-1443
www.medcominc.com

Insight Media Inc.
2162 Broadway
New York, NY 10024-0621
800-233-9910
www.insight-media.com

Films for the Humanities and Sciences
PO Box 2053
Princeton, NJ 08543-2053
800-257-5126
www.films.com

**SUGGESTED WEB SITES***

- http://harveyproject.org

  The Harvey Project is an international collaboration of educators, researchers, physicians, students, programmers, instructional designers, and graphic artists working together to build interactive, dynamic human physiology course materials on the World Wide Web. Materials produced by the Harvey Project are available free to educational institutions. The site is constantly updated and should be checked often and browsed for overall content. The address provided is for the home page. By clicking the WEB button, you will be taken to an index of links divided into categories such as general physiology and specific systems. The number of links in each category is indicated in parentheses after the topic.

- http://merck.com/health/

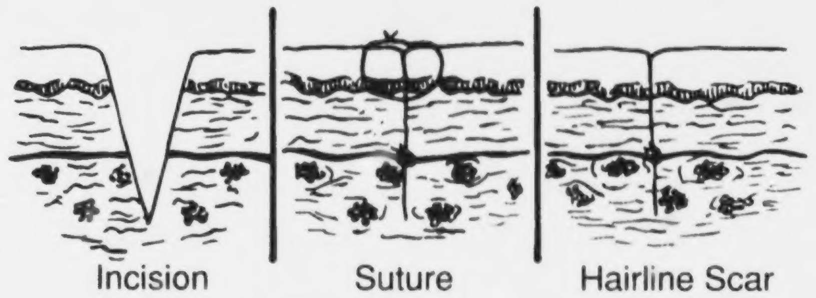
  This site provide a general guide to health that addresses many disorders.

- http://www.bu.edu/woundbiotech/index.html

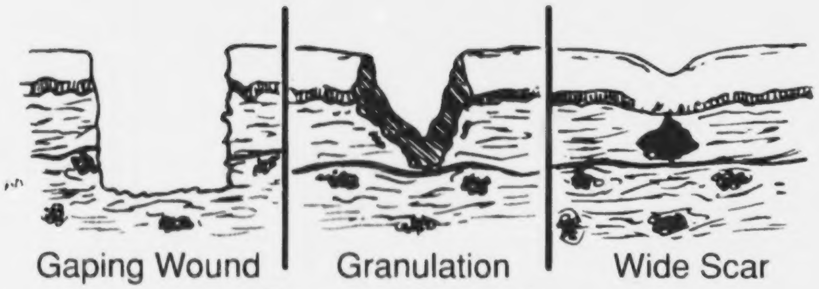
  This Web site contains information on the wound-healing process, common and uncommon wounds, and wound care.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

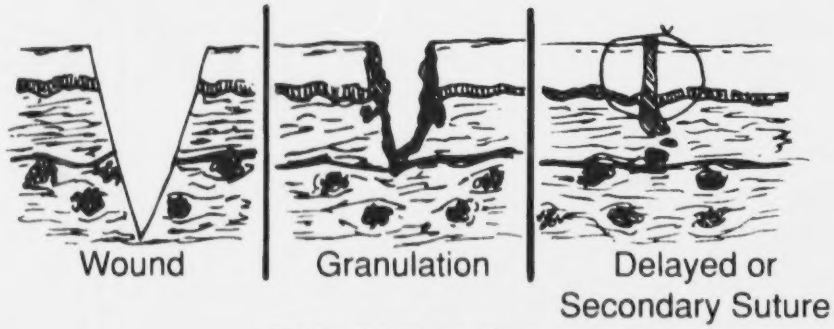
# Types of Wound Healing


Incision
Suture
Hairline Scar

First Intention

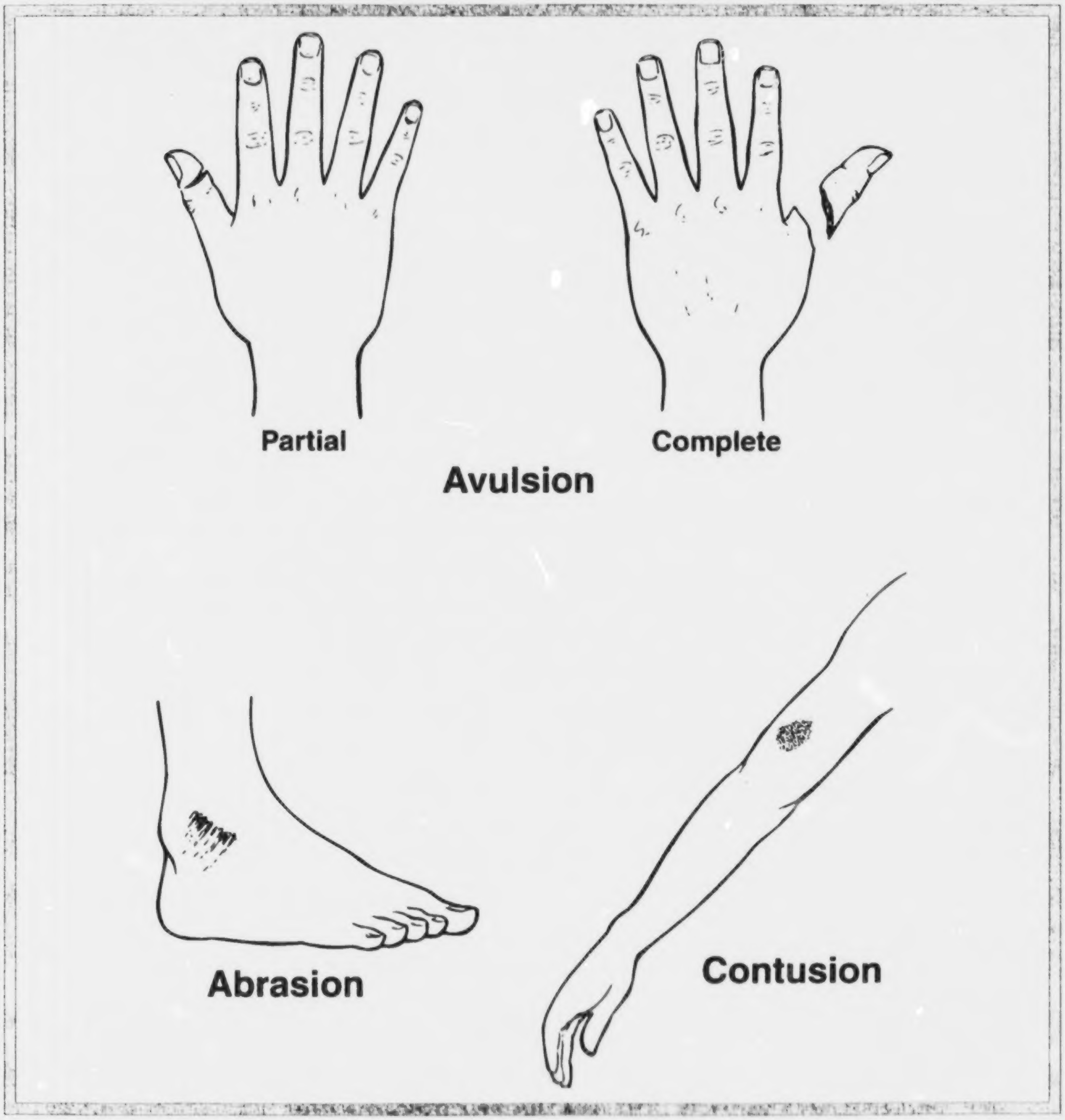

Gaping Wound
Granulation
Wide Scar

Second Intention

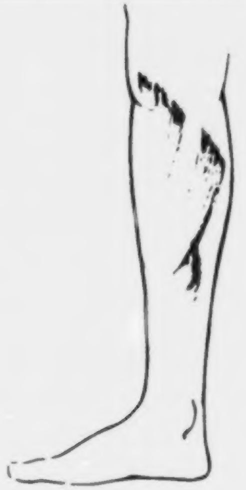

Wound
Granulation
Delayed or
Secondary Suture

Third Intention

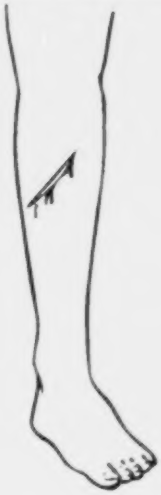
# Types of Traumatic Wounds


Partial
Complete
Avulsion
Abrasion
Contusion

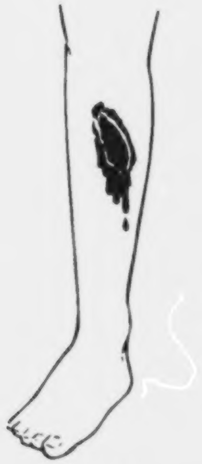
# Types of Traumatic Wounds
(Continued)



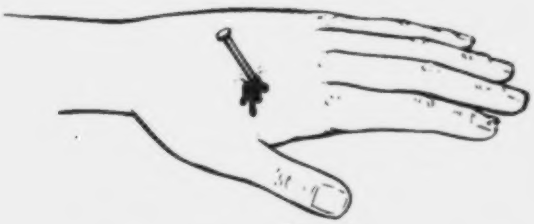
**Crushed**



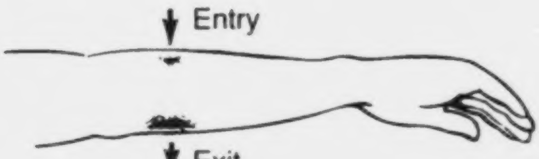
**Incised**



**Laceration**



**Puncture**



**Perforation**

# Introduction to Surgical Technology
## Section C: Microbiology
## Module 3-C: Wound Healing

## Written Test

Name ______________________________

Date ____________________ Score ____________________

**OBJECTIVE 1**

Match the types of injuries that can cause tissue damage on the right to their correct descriptions.

_______ a. An injury to body tissue that is the result of a response of the body to exposure to a chemical

_______ b. The death of cells as a result of the action of microorganisms

_______ c. The separation of intact tissue by a surgeon using aseptic techniques

_______ d. Local damage to tissue as a result of exposure to low temperatures

_______ e. An injury to living body tissue caused by an extrinsic agent

_______ f. Damage to tissue due to exposure to a high-energy source

1. Bacterial infection
2. Burn
3. Chemical reaction
4. Frostbite
5. Surgical incision
6. Traumatic wound

**OBJECTIVE 2**

Distinguish among the basic types of wounds by placing the following letters next to the correct descriptions:

- C—Chronic wound
- S—Surgical incision
- T—Traumatic injury

_____ a. Caused by chemical, thermal, or other extrinsic factors

_____ b. Caused by intrinsic factors, such as poor circulation

_____ c. Caused by a purposeful cut through intact skin

_____ d. Involves the use of aseptic technique

_____ e. Results in a wound that will not heal by second intention

**OBJECTIVE 3**

Distinguish among the types of wound healing by placing a "1st" next to the descriptions of healing by first intention, a "2nd" for second intention, and a "3rd" for third intention in the blanks provided.

Note: Some descriptions may have more than one answer.

_____ a. When a sutured wound becomes very infected after surgery, the primary sutures are removed and secondary sutures are put in later after infection subsides.

_____ b. Granulation tissue forms in the gap of the wound and closes it by contraction.

_____ c. Healing is by primary union.

_____ d. Scar formation is excessive.

_____ e. Healing may produce a weak union, which may be conducive to incisional herniation later.

_____ f. Wound is not closed (sutured).

_____ g. Healing is by process of granulation from the bottom up.

_____ h. Similar to second intention healing except wound is sutured, either delayed or secondary.

_____ i. Has no separation of wound edges and minimal scar formation ("hair line" scar).

_____ j. Healing takes longer than first intention.

_____ k. Has no postoperative swelling, serous discharge, or local infection.

**OBJECTIVE 4**

Complete the following statements concerning the phases of first intention wound healing by circling the correct answers or numbers.

a. The _______________ phase occurs between 1 – 6 days of healing.

(1) Lag (substrate)
(2) Healing (proliferative)
(3) Maturation (remodeling)

b. During the _______________ phase, collagen density increases, vascularity decreases, and the scar grows pale.

(1) Lag
(2) Healing
(3) Maturation

c. The _______________ phase occurs between days 14 and 21 days of healing.

(1) Lag
(2) Healing
(3) Maturation

d. During the _______________ phase, new cells are formed and tensile strength grows rapidly because of collagen.

(1) Lag
(2) Healing
(3) Maturation

e. During the _______________ phase, exudate loosely binds the cut edges together with a scab and leukocytes remove bacteria and damaged tissue.

(1) Lag
(2) Healing
(3) Maturation

f. The _______________ phase occurs between days 6 and 14 of healing.

(1) Lag
(2) Healing
(3) Maturation

**OBJECTIVE 5** Match the classes of traumatic wounds on the right to their correct descriptions.

_______ a. The skin is broken, and the object and/or condition surrounding the injury were relatively clean

_______ b. The skin is intact, but the underlying tissue is injured

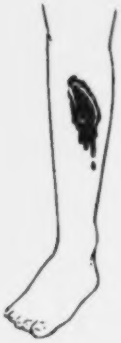
_______ c. The skin is interrupted but without loss or destruction of underlying tissue

_______ d. The skin and underlying tissues are injured or destroyed by crushing, burning, or implantation of a foreign object

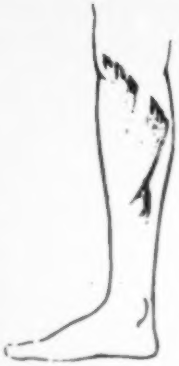
_______ e. The conditions and/or object surrounding the injury are obviously not clean

1. Closed
2. Open, clean
3. Open, complicated
4. Open, contaminated
5. Open, simple

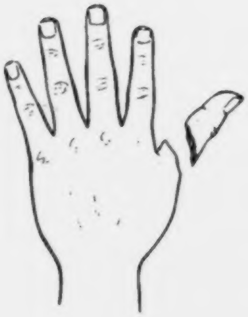
**OBJECTIVE 6** Identify the following types of traumatic wounds.



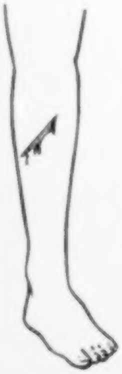
a. ______________________________



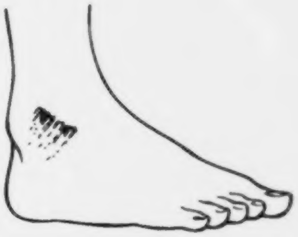
b. ______________________________



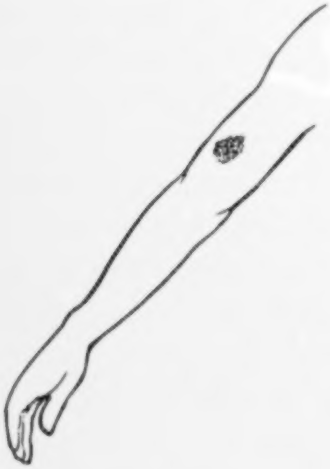
c. ______________________________



d. ______________________________



e. ______________________________



f. ______________________________

**OBJECTIVE 7**

Match the classifications of surgical wounds on the right to their correct descriptions.

______ a. (1) Open fresh traumatic wound of less than four hours old
  (2) Major break in aseptic technique occurred
  (3) Acute, nonpurulent inflammation present
  (4) Gross spillage/contamination from gastrointestinal tract
  (5) Entry into biliary or genitourinary tracts with infected bile or urine present

______ b. (1) Elective procedure; wound made under ideal conditions
  (2) Primary closure, no drain
  (3) No breaks in aseptic technique
  (4) No inflammation present
  (5) Alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity not entered

______ c. (1) Primary closure, wound drained
  (2) Minor breaks in aseptic technique occurred
  (3) No inflammation present
  (4) Alimentary, genitourinary, or respiratory tract or oropharyngeal cavity entered under controlled conditions—without unusual contamination or spillage

______ d. (1) Old traumatic wound of over four hours old from a dirty source or the presence of necrotic tissue, foreign body, or fecal material
  (2) Microbial contamination is present in the operative field before the procedure
  (3) Acute bacterial inflammation is present; may be purulent or there is a known clinical infection
  (4) Presence of a perforated organ such as a bowel

1. Clean
2. Clean-contaminated
3. Contaminated
4. Dirty and infected

**OBJECTIVE 8**

Select from the following list the correct factors affecting the wound healing process by placing an "X" in the appropriate blanks.

______ a. Skin tone and muscle tone increase (improve) with age.

______ b. Excess fat causes difficulty in confining and securing good closure, and is the most vulnerable of all tissues to trauma and infection.

______ c. Wound healing is impaired by deficiencies in zinc, protein, carbohydrates, and vitamins A, B, and C.

______ d. Radiation in large doses preoperatively speeds tissue healing.

______ e. Since wound healing is basically collagen synthesis, steroids have a positive effect on the healing process.

_____ f. Abnormalities in immune responses such as allergic reactions can contribute to delayed wound healing.

_____ g. Edema, vomiting, or coughing can place stress on the healing wound before fibroplasia takes place.

_____ h. Associated diseases such as diabetes, anemia, cirrhosis, and leukemia can delay the wound-healing process.

_____ i. Early ambulation decreases circulation and increases post operative complications.

_____ j. Outside influences not directly related to the surgery can interfere with wound healing.

**OBJECTIVE 9** Describe the factors that present possible complications to the wound-healing process. Write your answers on the blank lines provided below.

a. Hemorrhage—______________________________

______________________________

______________________________

b. Sinus-tract formation—______________________________

______________________________

______________________________

c. Hematoma—______________________________

______________________________

d. Infection—______________________________

______________________________

e. Herniation—______________________________

______________________________

f. Wound disruption—______________________________

______________________________

**OBJECTIVE 10**

Complete the following statements concerning the effects of operative technique on wound healing by circling the correct answers or numbers.

a. Which of the following best describes the effects of aseptic technique on wound healing?

(1) Aseptic technique is important on the part of the surgeon.
(2) Aseptic technique has minimal effect on wound healing.
(3) Aseptic technique applies to tissue approximation and tissue handling to some extent.
(4) Aseptic technique must be followed by all of the operating room team to promote healing and prevent infection.

b. ________________ must be achieved to prevent loss of the patient's blood and to provide conditions for accurate dissection.

(1) Homostasis
(2) Hetrostasis
(3) Hemostasis
(4) Hemeostasis

c. All of the following are true about tissue handling EXCEPT:

(1) All tissues should be handled as gently as possible.
(2) Incisions should be extended as long as possible to enhance exposure.
(3) Retractors are placed to provide exposure but without causing pressure on organs.
(4) Careful consideration is given to underlying blood vessels and nerves.

d. All of the following are true about tissue approximation EXCEPT:

(1) Precision is used to create a dead space to promote healing.
(2) Closure that is too tight will cause ischemia.
(3) Wound edges not closely approximated may delay healing.
(4) Serum or blood that collects in a dead space may delay healing.

e. All of the following are true about wound closure EXCEPT:

(1) Suture materials provide all of the strength of the wound immediately after closure.
(2) Closely spaced sutures give a stronger suture line.
(3) To minimize tissue reaction, the least amount and smallest size suture consistent with the holding power of the tissue is used.
(4) Drainage tubes strengthen a wound and should be placed in the center of the wound.

**OBJECTIVE 11**

Distinguish among types of wound disruption by placing an "X" next to the description of evisceration.

_____ a. Separation of the layers of a surgical wound

_____ b. Extrusion of internal organs or viscera resulting from wound dehiscence. A portion of the wound may remain closed.

_____ c. Partial protrusion of the abdominal contents through an opening in the abdominal wall

**OBJECTIVE 12**

Complete the following statements concerning characteristics of wound disruption by circling the correct answers.

a. May occur in a **(small, large)** percentage of clean surgical abdominal wounds

b. Usually happens between **(1st and 2nd, 3rd and 4th, 4th and 6th)** postoperative day

c. One symptom may be a profuse amount of **(clear, sero-sanguinous)** drainage on abdominal dressing

d. Possible causes include infection, type and direction of incision, and **(emotional, nutritional)** status of patient.

***Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1**

a. 3
b. 1
c. 5
d. 4
e. 6
f. 2

**OBJECTIVE 2**

a. T
b. C
c. S
d. S
e. C

**OBJECTIVE 3**

a. 3rd
b. 2nd
c. 1st
d. 2nd
e. 2nd, 3rd
f. 2nd
g. 2nd
h. 3rd
i. 1st
j. 2nd, 3rd
k. 1st

**OBJECTIVE 4**

a. (1) Lag (substrate)
b. (3) Maturation
c. (3) Maturation
d. (2) Healing
e. (1) Lag
f. (2) Healing

**OBJECTIVE 5**

a. 2
b. 1
c. 5
d. 3
e. 4

**OBJECTIVE 6**

a. Laceration
b. Crushed
c. Avulsion
d. Incised
e. Abrasion
f. Contusion

**OBJECTIVE 7**

a. 3
b. 1
c. 2
d. 4

**OBJECTIVE 8**

b, c, f, g, h, j

**OBJECTIVE 9**

a. The loss of a large amount of blood in a short time caused by a failure of open blood vessels to adequately clot or to remain sealed
b. The development of channels that permit the escape of purulent materials from pockets of pus and other fluids
c. A swelling or tumor that contains blood that is generally clotted
d. The presence of pathogens in a wound site
e. A protrusion of an organ or tissue structure into a wound site
f. One of the conditions—dehiscence, evisceration, or eventration—that interrupts the wound-healing process.

**OBJECTIVE 10**

a. (4) Aseptic technique must be followed by all of the operating room team to promote healing and prevent infection.
b. (3) Hemostasis
c. (3) Retractors are placed to provide exposure but without causing pressure on organs.
d. (1) Precision is used to create a dead space to promote healing.
e. (4) Drainage tubes strengthen a wound and should be placed in the center of the wound.

**OBJECTIVE 11**

b

**OBJECTIVE 12**

a. small
b. 4th and 6th
c. sero-sanguinous
d. nutritional

## Answers to Assignment Sheets

### Assignment Sheet 1

1. Dirty and infected
2. Clean-contaminated
3. Dirty and infected
4. Clean
5. Contaminated
6. Complicated, contaminated
7. Simple, contaminated
8. Simple, clean
9. Complicated, contaminated
10. Complicated, contaminated

### Assignment Sheet 2

1. Perforation
2. Crushed
3. Avulsion, partial
4. Puncture
5. Incised
6. Laceration
7. Abrasion
8. Contusion

### Assignment Sheet 3

1. N
2. N
3. P
4. P
5. P
6. N
7. N
8. P
9. P
10. N
11. N
12. N
13. P
14. N
15. P
16. N
17. P
18. P
19. P
20. N
21. P
22. N
23. N
24. P
25. N
26. P

## Module Review

Name ______________________________

Date ______________________ Score ______________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 8

1. How does an infection affect the wound healing process?
   a. reduces the amount of nutrients, oxygen, and other substances that can be involved in the healing process
   b. pathogens may produce toxins that interfere with the body's chemicals that are involved in healing
   c. tissues that are combating infection are slow to heal because the infection interferes with the healing process
   d. all of the above

Objective 4

2. Which days of first intention wound healing are considered the healing (proliferative) phase?
   a. days 1–6
   b. days 6–14
   c. days 14-21
   d. days 21-30

Objective 10

3. What is ischemia?
   a. death of tissue cells
   b. separation of layers of a surgical wound
   c. decrease of blood supply to the tissue
   d. blood-tinged or colored serous drainage

Objective 12

4. Which of the following statements are TRUE concerning wound disruption?
   a. occurs in a large percentage of clean, surgical, abdominal wounds
   b. usually happens between the 1st and 3rd postoperative day
   c. may be a profuse amount of sero-sanguinous drainage on abdominal dressing
   d. none of the above

Objective 2

5. A wound that will not heal by second intention and may be caused by extrinsic or intrinsic factors is called a ______________________________.

   a. chronic wound

   b. traumatic injury

   c. surgical incision

   d. chemical reaction

Objective 7

6. Which of the following statements is TRUE concerning a dirty and infected wound?

   a. presence of a perforated organ such as a bowel

   b. elective procedure; wound made under ideal conditions

   c. no inflammation present

   d. open fresh traumatic wound of less than four hours old

Objective 4

7. What is a leukocyte?

   a. red blood cell

   b. white blood cell

   c. collagen

   d. none of the above

Objective 3

8. Which of the following is the correct definition for debridement?

   a. dense, unsightly connective tissue or excessive scar formation that is often removed surgically

   b. to bring two tissue surfaces close together, as in the repair of a wound

   c. formulation of new tissue, composed largely of newly growing capillaries which form in types of wounds left open

   d. removal of foreign materials; cutting away all dead and devitalized tissues leaving an open, clean wound where anaerobic organisms cannot survive

Objective 4

9. Which of the following is a connective tissue cell that produces collagen and elastin fibers?

   a. thrombin

   b. fibrin

   c. fibroblast

   d. fibrinogen

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Objective 5

10. What type of wound is over six hours old and the conditions and/or object surrounding the injury are obviously not clean?

    a. closed wound

    b. clean wound

    c. simple wound

    d. contaminated wound

Objective 4

11. Which of the following is TRUE of the lag phase of first intention wound healing?

    a. Tensile strength grows rapidly because of collagen.

    b. Leukocytes remove bacteria and damaged tissue debris.

    c. Scar forms.

    d. New cells are formed.

Objective 5

12. A cut that occurs when unloading a dishwasher is an example of a(n) ____________ wound.

    a. clean

    b. closed

    c. simple

    d contaminated

Objective 6

13. Which of the following describes a contusion?

    a. a bruise that may be caused by a blunt instrument in which skin is not broken, the tissues below the surface are damaged, and the blood vessels have ruptured causing discoloration

    b. a portion of the skin and soft tissue is partially or completely torn away

    c. a wound caused by mechanical irritation

    d. a wound with smooth edges that is made by a cutting instrument

Objective 6

14. Which of the following is defined as torn wound with irregular edges?

    a. contusion

    b. puncture

    c. perforation

    d. laceration

Objective 9

15. Dehiscence, evisceration, and eventration are all examples of ________________.

    a. wound disruption

    b. infection

    c. herniation

    d. sinus-tract formation

Objective 8

16. Which of the following is FALSE concerning the wound healing process?

    a. Early ambulation decreases circulation and increases post operative complications

    b. Abnormalities in immune response such as allergic reactions can contribute to delayed wound healing.

    c. Healing is delayed if the patient has had radiation in large doses preoperatively.

    d. Wound healing is impaired by deficiencies in zinc, protein, carbohydrates, and vitamins A, B, and C.

Objective 12

17. Wound disruptions may be caused by which of the following?

    a. infection

    b. abdominal distention

    c. coughing, straining, unusual activity

    d. all of the above

Objective 3

18. Which of the following statements is TRUE of healing by first intention?

    a. has relatively slow healing

    b. has separation of wound edges

    c. has postoperative swelling

    d. has no serous discharge or local infection

Objective 8

19. How does Vitamin C play a part in the wound healing process?

    a. permits collagen formation

    b. aids in the production of connective tissue and a strong scar

    c. provides essential amino acids for new tissue construction

    d. both a and b

Objective 3

20. What is a cicatrix?

a. situation in which severed tissue is essentially reunited with the tissue from which it was originally separated

b. union of two surfaces or structures that normally are separate

c. stitch placed in tissue to hold the sides of a wound together

d. scar left by a healed wound

Objective 9

21. A swelling or tumor that contains blood that is generally clotted is called a ________________.

a. hemorrhage

b. hematoma

c. sinus-tract formation

d. herniation

Objective 1

22. Which of the following is the correct definition for a bacterial infection?

a. the separation of intact tissue by a surgeon using aseptic techniques

b. local damage to tissue as a result of exposure to low temperatures

c. damage to tissue due to exposure to a high-energy source

d. the death of cells as a result of the action of microorganisms

Objective 4

23. Which of the following is TRUE of the maturation phase of first intention wound healing?

a. Exudate containing blood, lymph, and fibrin begins clotting and loosely binds the cut edges together.

b. Fibrin, clotting blood, and serum protein dry out, forming a scab which seals the wound.

c. As collagen density increases, vascularity decreases, and the scar grows pale.

d. Tensile strength grows rapidly because of collagen.

Objective 10

24. Which of the following is FALSE concerning the effects of operative technique on wound healing?

a. All tissues should be handled as gently and as little as possible throughout the procedure.

b. Laparoscopes are not used very often because they maximize tissue trauma and slow healing.

c. Aseptic technique must be followed by all operating room team.

d. Hemostasis must be achieved to prevent loss of the patient's blood and to provide as bloodless a field as possible for accurate dissection.

Objective 7

25. What is the expected infection rate of a clean-contaminated wound?

    a. 1% to 5%

    b. 8% to 11%

    c. 15% to 20%

    d. 27% to 40%

Objective 3

26. Which of the following is FALSE concerning healing by third intention?

    a. There may be loss of tissue due to infections or complications of the healing process.

    b. A deeper and wider scar usually results.

    c. Healing is quicker than first intention.

    d. There is excessive separation of the wound edges due to disruption of the healing process.

Objective 11

27. Partial protrusion of the abdominal contents through an opening in the abdominal wall is called ____________________.

    a. eventration

    b. evisceration

    c. dehiscence

    d. none of the above

Objective 1

28. Which of the following is defined as an injury to living body tissue caused by an extrinsic agent?

    a. surgical incision

    b. traumatic wound

    c. chemical reaction

    d. frostbite

Objective 3

29. Which of the following is FALSE concerning healing by second intention?

    a. Wound is sutured.

    b. Healing is by process of granulation from the bottom up.

    c. Scar formation is excessive.

    d. There is serous discharge.

Objective 4

30. ____________________ is a white protein contained in connective tissue and bones.

a. Thrombin

b. Fibrin

c. Fibrinogen

d. Collagen

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. d
2. b
3. c
4. c
5. a
6. a
7. b
8. d
9. c
10. d
11. b
12. a
13. a
14. d
15. a
16. a
17. d
18. d
19. d
20. d
21. b
22. d
23. c
24. b
25. b
26. c
27. a
28. b
29. a
30. d

# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

### Module 1-D: Basic Math

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Read the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you many want to use to supplement the instruction of this module. See "Resources Used in Developing This Module", and "Suggested Supplemental Resources" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**EVALUATION**

- Make copies of the pretest. Add or modify test items as needed. The pretest assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as a posttest to assist in measuring each student's competency gains.

- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Give and evaluate the posttest.
- Compile the Pretest, Written Test, and assignment-sheet scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

- If a student has satisfactorily passed in a certain area(s) of the pretest, consider letting him/her skip studying the objective(s) and completing the assignment sheet that pertains to that area.
- Play "You Inherit" with the students to help them learn place values. Ask students to tell you the least amount they inherit when you give them the amount in numbers of digits.

  Examples: Q. "You have just inherited a six-digit sum. What is the least amount you inherit?"

  A. "One hundred thousand dollars."
- On different tables arrange groups of small objects related to surgical technology to be added, subtracted, multiplied, divided, stated as a percentage, etc. Have students stop at each table and perform the math procedures indicated. Provide each student with a work sheet on which the equations and answers can be written.
- Have students play dominoes. Score ends in multiples of five and play to 250, or score ends at the end of each turn and play to 1,000 points.
- Develop or purchase sets of flashcards for the various math functions. Use the cards to review students in the math functions they need practice with.
- Sit students in a circle. Have all students clap hands twice on legs, then clap hands together twice, then snap fingers twice to establish a rhythm that is to continue unbroken throughout the games. The caller gives a multiplication (or other operation) problem such as 8x6 while snapping fingers, and at the next finger snapping says the name of someone to answer the problem. The responder gives the answer at the next finger snapping without breaking the clap/snap rhythm. If the responder breaks the rhythm or gives an incorrect answer, then he or she is out of the game. The last person left is the winner.
- Have students practice measuring using a ruler by measuring various items in the classroom or lab. Have students record their measurements on a sheet of paper, and then have them convert their measurements to improper fractions. After they have improper fractions, have them give their lists to another student who then converts the improper fractions to mixed numbers.

- Assign monetary values to each letter of the alphabet: A=\$.05, B=\$.10, C=\$.15, D=\$.25, E=\$1.00, Z=\$20.00. Then have students calculate such problems as: Who has the most valuable name? What piece of operating room equipment has the most valuable name?

- Illustrate percentages by providing students with graph or grid paper. Have students outline at least eight 10 x 10 block squares. Since each block contains 100 units or small squares, students can shade in enough units to illustrate 25 percent, 33 1/2 percent, 50 percent, 96 percent, and so on.

**RESOURCES USED IN DEVELOPING THIS MODULE**

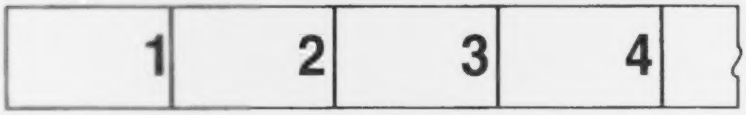
**Books**

- *Graphic Arts: Orientation, Composition, and Paste-Up*, Unit 3, "Related Math and Measuring." Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium, 2000.

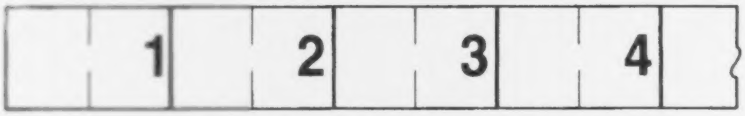
- Snyder, Katherine, and Chris Keegan. *Pharmacology for the Surgical Technologist.* Philadelphia: W.B. Saunders Co., 1999.

# Graduations on a Rule

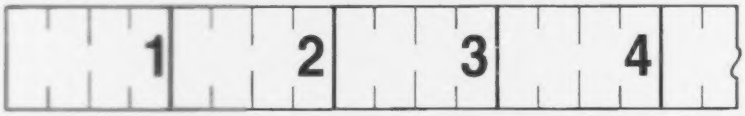
Inches



Halves

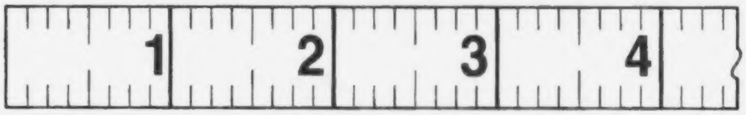


Quarters or Fourths

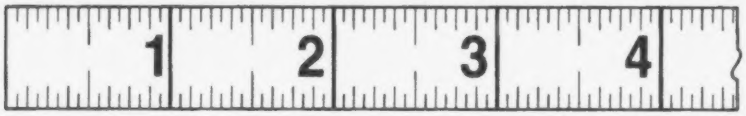


# Graduations on a Rule (continued)

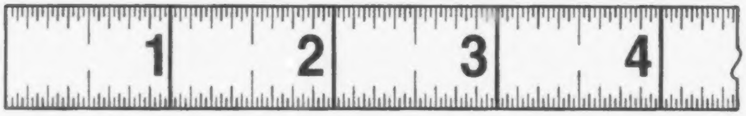
Eighths



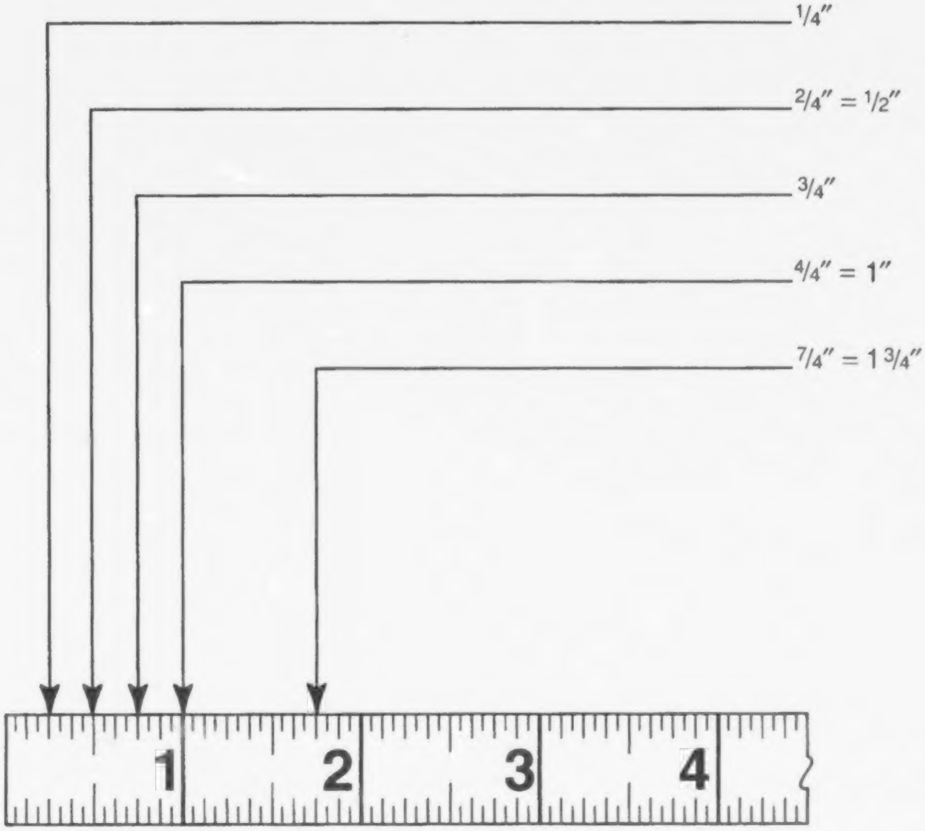
Sixteenths



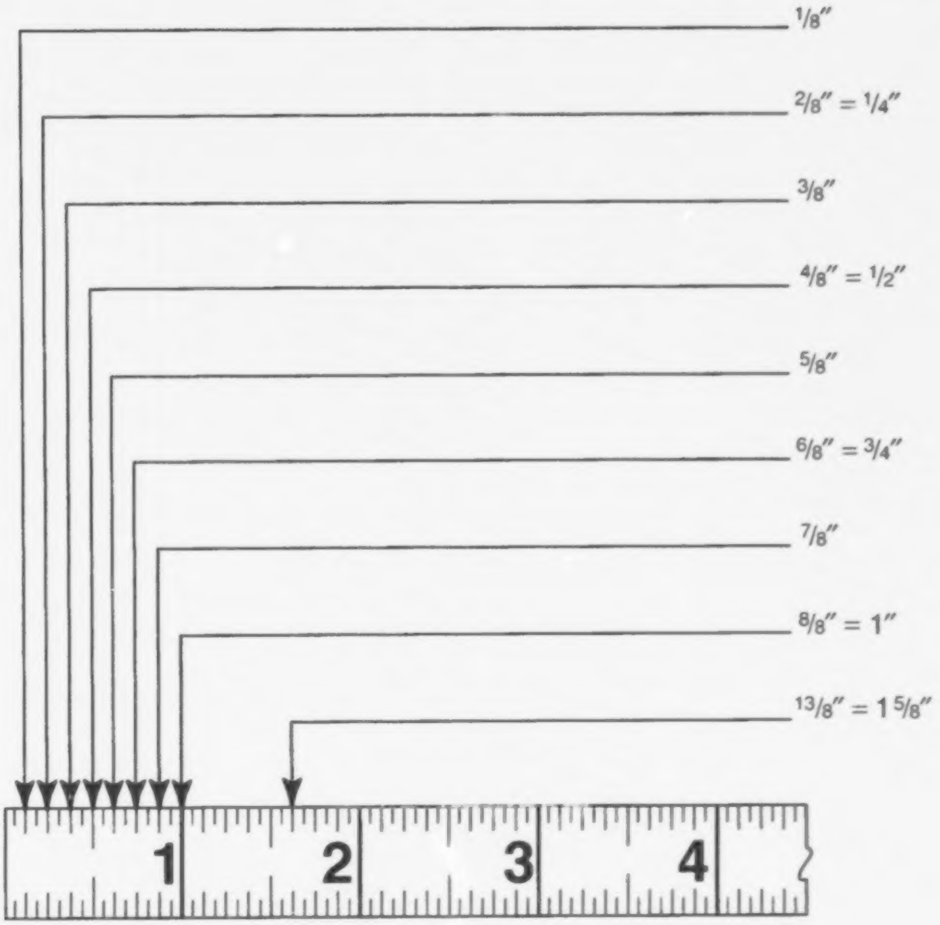
Thirty-Seconds



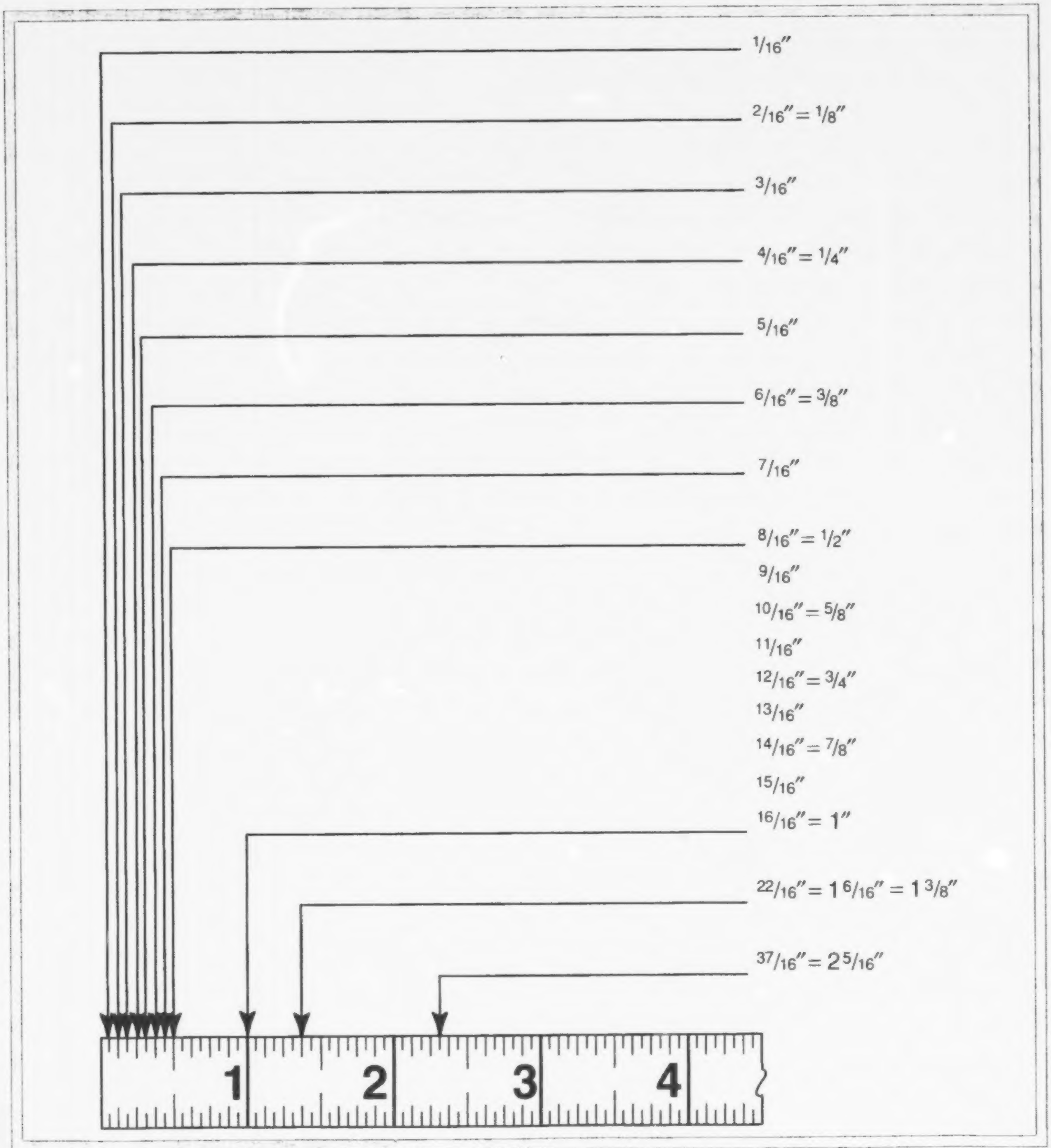
# Reading Fourths on a Rule


1/4"
2/4" = 1/2"
3/4"
4/4" = 1"
7/4" = 1 3/4"
1
2
3
4

# Reading Eighths on a Rule


1/8"
2/8" = 1/4"
3/8"
4/8" = 1/2"
5/8"
6/8" = 3/4"
7/8"
8/8" = 1"
13/8" = 1 5/8"
1
2
3
4

# Reading Sixteenths on a Rule


1/16″
2/16″ = 1/8″
3/16″
4/16″ = 1/4″
5/16″
6/16″ = 3/8″
7/16″
8/16″ = 1/2″
9/16″
10/16″ = 5/8″
11/16″
12/16″ = 3/4″
13/16″
14/16″ = 7/8″
15/16″
16/16″ = 1″
22/16″ = 1 6/16″ = 1 3/8″
37/16″ = 2 5/16″
1
2
3
4

## Pretest

Name ______________________________

Date ____________________ Score ____________________

1 Select correct definitions of math terms. Write a "T" in the blank before each correct definition.

_____ a. **Fraction** is part of a whole; it represents one or more equal parts of a unit.

_____ b. **Digit** is any of the natural numbers, both positive and negative, that represents a complete item.

_____ c. **Subtraction** is the opposite (inverse) operation of addition.

_____ d. **Whole number (integer)** is any of the ten symbols, 0 to 9, by which all numbers can be expressed.

_____ e. **Percent** is a fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number.

_____ f. **Multiplication** is an abbreviated process of adding a number to itself a specified number of times.

_____ g. **Decimal** is one part in a hundred; reckoned on the basis of a whole divided into one hundred parts.

_____ h. **Division** is the opposite (inverse) operation of multiplication.

_____ i. **Liter** is the metric unit used to measure capacity.

_____ j. **Ratio** is being relatively equal in size or quantity.

_____ k. **Addition** is the process of totaling two or more numbers to find another number called a sum.

_____ l. **Meter** is the metric unit used to measure length.

_____ m. **Proportional** is the relationship in quantity, amount, or size between two or more things.

**2** Match symbols used in basic math with their correct names. Write the correct numbers in the blanks.

_______ a. Plus sign (addition) 1. .

_______ b. Equal sign 2. %

_______ c. Division frame 3. :

_______ d. Ratio symbol 4. $\overline{)\quad}$

_______ e. Minus sign (subtraction) 5. =

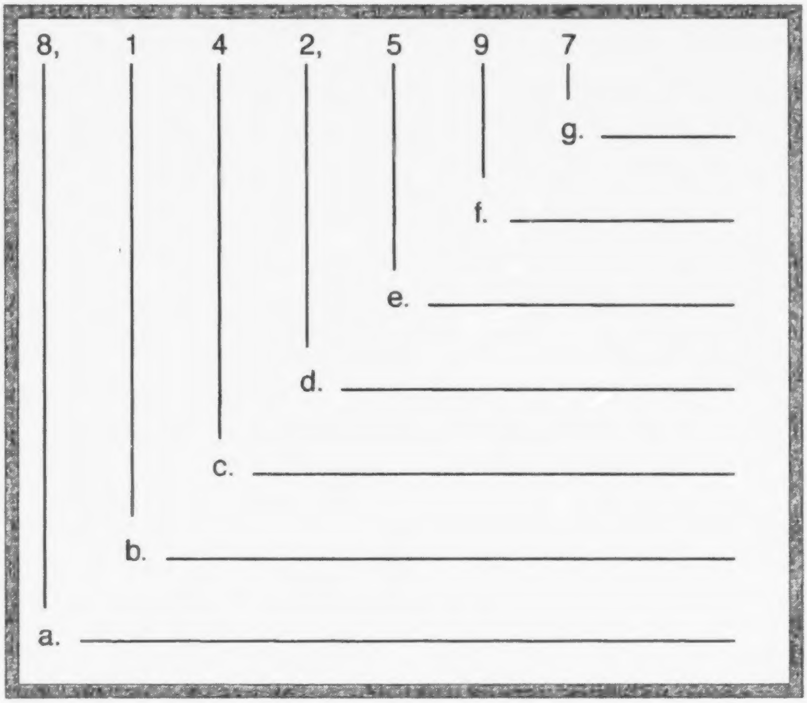
_______ f. Percent symbol 6. x

_______ g. Times sign (multiplication) 7. –

_______ h. Decimal point 8. ÷

_______ i. Division sign 9. +

**3** Label the place values in the whole number below.



4 Add whole numbers to solve the following problems.

a. $\begin{array}{r} 7 \\ \underline{+\ 11} \end{array}$

b. $\begin{array}{r} 5 \\ 10 \\ \underline{+\ 15} \end{array}$

c. $\begin{array}{r} 40 \\ 159 \\ \underline{+\ 200} \end{array}$

5 Subtract whole numbers to solve the following problems.

a. $\begin{array}{r} 8 \\ \underline{-\ 3} \end{array}$

b. $\begin{array}{r} 47 \\ \underline{-\ 22} \end{array}$

c. $\begin{array}{r} 477 \\ \underline{-\ 222} \end{array}$

6 Multiply whole numbers to solve the following problems.

a. $\begin{array}{r} 6 \\ \underline{\times\ 3} \end{array}$

b. $\begin{array}{r} 75 \\ \underline{\times\ 56} \end{array}$

c. $\begin{array}{r} 424 \\ \underline{\times\ 138} \end{array}$

7 Divide whole numbers to solve the following problems.

a. $3\overline{)96}$

b. $24\overline{)96}$

c. $135\overline{)541}$

8 Distinguish among types of fractions. Write a "P" in the blanks before the proper fractions, an "I" before improper fractions, and an "M" before mixed numbers.

_____ a. 5/3

_____ b. 3/8

_____ c. 20/100

_____ d. 1 3/15

_____ e. 5/5

9 Reduce the following fractions to lowest terms. Write your answers in the blanks.

_____ a. 2/8

_____ b. 4/32

_____ c. 5/25

_____ d. 8/32

_____ e. 9/81

10 Convert the following mixed numbers to improper fractions. Reduce to lowest terms. Write your answers in the blanks.

_____ a. 2 1/4

_____ b. 6 7/8

_____ c. 15 5/10

11 Convert the following improper fractions to mixed numbers. Reduce to lowest terms. Write your answers in the blanks.

_____ a. $^{27}/_{4}$

_____ b. $^{63}/_{8}$

_____ c. $^{221}/_{6}$

12 Add fractions to solve the following problems. Convert to mixed numbers if necessary, and reduce to lowest terms. Write your answers in the blanks.

_____ a. $^{2}/_{8} + {}^{5}/_{8}$

_____ b. $^{7}/_{16} + 5\ ^{1}/_{4}$

_____ c. $4\ ^{1}/_{2} + 8\ ^{1}/_{16}$

13 Subtract fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks.

_____ a. $^{5}/_{8} - {}^{3}/_{8}$

_____ b. $^{15}/_{16} - {}^{3}/_{8}$

_____ c. $3\ ^{5}/_{8} - 2\ ^{3}/_{16}$

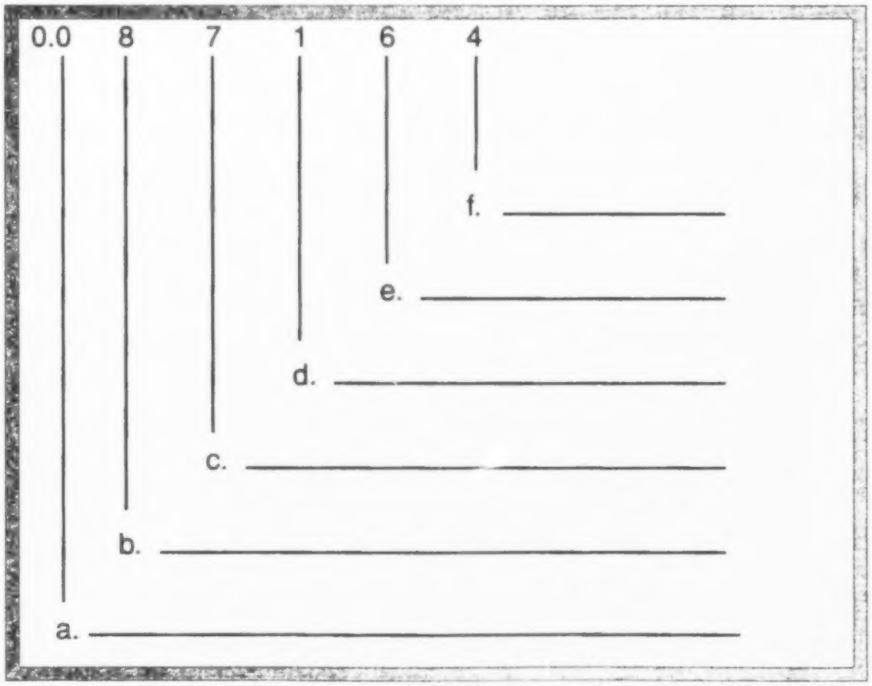
14 Multiply fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks.

_____ a. $^{3}/_{4} \times {}^{5}/_{8}$

_____ b. $^{3}/_{8} \times 5\ ^{1}/_{4}$

_____ c. $8\ ^{1}/_{2} \times 2\ ^{3}/_{4}$

15 Label the place values in the decimal number below.



16 Add decimal numbers to solve the following problems. Write your answers in the blanks.

_____ a. $7.32 + $.68 + $4.39

_____ b. 8.40 + 0.87

_____ c. 64.018 + .0473

17 Subtract decimal numbers to solve the following problems. Write your answers in the blanks.

_____ a. $16.20 – $8.10

_____ b. 41.032 – 20.008

_____ c. 0.7964 – 0.4431

18 Multiply decimal numbers to solve the following problems. Write your answers in the blanks.

_____ a. 4.5 x 7.5

_____ b. .248 x 00.45

_____ c. 8.064 x 3.435

19 Divide decimal numbers to solve the following problems. Write your answers in the blanks.

_____ a. 3.15 ÷ 0.7

_____ b. 6.25 ÷ 0.05

_____ c. 72 ÷ .085

20 Convert the following decimal fractions to common fractions. Write your answers in the blanks.

_____ a. .8

_____ b. .35

_____ c. .840

21 Convert the following common fractions to decimal numbers and percentages. Give percentages in the nearest whole percent. Write your answers in the blanks.

| Decimals | Percentages | | |
|---|---|---|---|
| __________ | __________ | a. | 3/4 |
| __________ | __________ | b. | 5/14 |
| __________ | __________ | c. | 26 6/100 |

22 Convert the following percentages to fractions and decimal numbers. Write your answers in the blanks.

| Decimals | Fractions | |
|---|---|---|
| ____________ | ____________ | a. 15% |
| ____________ | ____________ | b. 40% |
| ____________ | ____________ | c. 125% |

23 Solve the following percentage problems. Write your answers in the blanks.

_____ a. If a doctor paid a scrub tech $150.00 which is 80 percent of her salary, how much money would the doctor still owe?

_____ b. If 15 percent of the sterile gloves in storage are stolen, how many pairs of gloves will be left of the 2400 pairs in storage?

_____ c. If the hospital purchased orthopedic implants for $48,000 and sold them to patients for $60,000, what would be the percentage of profit?

24 Solve the following story problems. Write your answers in the blanks.

_____ a. In the first year of operation, the operating room completed 1219 cases. During the second year, the number of cases increased to 2167. How many more cases did surgery complete the second year?

_____ b. To complete a certain operation takes 65 minutes. If you have already worked 27 minutes, how much longer will the operation take?

_____ c. Surgery has 9 cases of sterile gowns available for use. They have ordered and received 8 additional boxes. How many total boxes do they have in stock?

_____ d. Surgery completed the following numbers of orthopedic cases during 4 months: 256, 62, 575, and 242. What is the total number of orthopedic cases completed during those 4 months?

_____ e. If it takes 35 minutes to put together a set of instruments, how long will it take to put together 9 sets?

_____ f. If there are 4 retractors in an instrument set, how many instrument sets can you have set up if you have 416 retractors?

_____ g. If a spray pump holds 5 gallons of cleaner, how many spray pumps can you fill from a 55-gallon drum?

_____ h. If there are 500 pairs of gloves in a case, how many are there in 6 cases?

_____ i. What is the combined length of two bolts that measure 3 $^{1}/_{2}$ inches and 4 $^{1}/_{4}$ inches?

_____ j. Samuel worked 4 $^{1}/_{2}$ hours before lunch and 4 $^{3}/_{4}$ hours after lunch. How many hours did Samuel work?

_____ k. What is the combined length of three tools measuring 2 $^{1}/_{8}$ inches, 3 $^{1}/_{4}$ inches, and 1 $^{13}/_{16}$ inches?

_____ l. Sarah had a $^{7}/_{8}$-inch screw. She needed a $^{3}/_{4}$-inch screw. What is the difference in the lengths of the screws?

_____ m. 5 $^{1}/_{4}$ hours are how many more than 2 $^{1}/_{2}$ hours?

_____ n. If you had to reduce a $^{15}/_{16}$-inch part by $^{7}/_{8}$ inch, how much would you have to reduce it?

_____ o. For the repair of an operating microscope, parts cost $54.65, labor costs $16.30, and mileage cost for the technician is $3.38. What is the total cost of the repair?

_____ p. In one month, a surgeon's office had the following expenses: sterile supplies, $429.33; electric bill, $160.16; telephone, $116.27; and labor, $40,312.50. What was the office's monthly expenditure?

_____ q. The surgeon's office received $8438.64 this month and paid out $5121.32. How much profit did the surgeon make?

_____ r. It takes 20.5 hours to finish a job. Mary has worked 6 hours. How many hours will it take her to finish the job?

_____ s. The average cost of cleaning the lounge and dressing room is $41.25. During the year, the area was cleaned 150 times. What was the total cost?

_____ t. Surgery purchases 38 sterile vinyl gloves at a cost of $3.49 each. What is the total cost?

_____ u. If instrument milk costs $6.00 per gallon, how much will 58 gallons of instrument milk cost?

_____ v. Naoki received $361.00 for several days of first assisting. She worked 19 hours. How much did she make per hour?

_____ w. A surgeon paid $729.00 for 13.5 weeks of part-time help. Find the average earnings per week for the part-time help.

_____ x. If 32 instrument sets can be sterilized and wrapped in 3.9 days, how many instrument sets can be wrapped in 1 day? Round your answer to the nearest tenth.

25 Convert the following Arabic numerals to Roman numerals.

_____ a. 16

_____ b. 88

_____ c. 11

_____ d. 55

_____ e. 96

_____ f. 90

_____ g. 500

***Permission to duplicate this test is granted.**

## Answers to Pretest

**1** a, c, f, h, i, k, l

**2**
a. 9
b. 5
c. 4
d. 3
e. 7
f. 2
g. 6
h. 1
i. 8

**3**
a. Millions
b. Hundred thousands
c. Ten thousands
d. Thousands
e. Hundreds
f. Tens
g. Units

**4**
a. 18
b. 30
c. 399

**5**
a. 5
b. 25
c. 255

**6**
a. 18
b. 4200
c. 58512

**7**
a. 32
b. 4
c. 4 with 1 R

**8**
a. I
b. P
c. P
d. M
e. I

| | |
|---|---|
| **9** | a. 1/4<br>b. 1/8<br>c. 1/5<br>d. 1/4<br>e. 1/9 |
| **10** | a. 9/4<br>b. 55/8<br>c. 155/10 |
| **11** | a. 6 3/4<br>b. 7 7/8<br>c. 36 5/6 |
| **12** | a. 7/8<br>b. 5 11/16<br>c. 12 9/16 |
| **13** | a. 1/4<br>b. 9/16<br>c. 1 7/16 |
| **14** | a. 15/32<br>b. 1 31/32<br>c. 23 3/8 |
| **15** | a. Tenths<br>b. Hundredths<br>c. Thousands<br>d. Ten thousandths<br>e. Hundred thousandths<br>f. Millionths |
| **16** | a. $12.39<br>b. 9.27<br>c. 64.0653 |
| **17** | a. $8.10<br>b. 21.024<br>c. 0.3533 |
| **18** | a. 33.75<br>b. .11160<br>c. 27.699840 |

**19**
a. 4.5
b. 125
c. 847.05882

**20**
a. 4/5
b. 7/20
c. 21/25

**21**
a. 0.75; 75%
b. .3572; 36%
c. 26.06; 2606%

**22**
a. 0.15; 3/20
b. 0.40, 2/5
c. 1.25; 1 1/4

**23**
a. $37.50
b. 2040 pairs
c. 20 percent

**24**
a. 948
b. 38
c. 17
d. 1135
e. 315
f. 104
g. 11
h. 3000
i. 7 3/4
j. 9 1/4
k. 7 3/16
l. 1/8
m. 2 3/4
n. 1/16
o. $74.33
p. $41,018.26
q. $3317.32
r. 14.5
s. $6187.50
t. $132.62
u. $348
v. $19
w. $54
x. 8.2

**25**
a. XVI
b. LXXXVIII
c. XI
d. LV
e. XCVI
f. XC
g. D

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 1-D: Basic Math

## Written Test

Name ______________________________

Date ______________ Score ______________

**OBJECTIVE 1**

Match the terms to their correct descriptions. Write the numbers on the blanks provided.

______ a. Process of totaling two or more numbers to find another number called a sum

______ b. Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

______ c. Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

______ d. Opposite (inverse) operation of multiplication

______ e. Part of a whole; represents one or more equal parts of a unit

______ f. Any of the natural numbers, both positive and negative, that represents a complete item

______ g. Abbreviated process of adding a number to itself a specified number of times

______ h. Metric unit used to measure capacity

______ i. One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

______ j. Metric unit used to measure length

______ k. Being relatively equal in size or quantity

______ l. Relationship in quantity, amount, or size between two or more things

______ m. Opposite (inverse) operation of addition

1. Digit
2. Multiplication
3. Meter
4. Liter
5. Subtraction
6. Whole number (integer)
7. Addition
8. Fraction
9. Ratio
10. Proportional
11. Division
12. Decimal
13. Percent

## Module 1-D: Basic Math

**OBJECTIVE 2**

Match symbols used in basic math with their correct names. Write the correct numbers in the blanks.

_______ a. Plus sign (addition) 1. .

_______ b. Equal sign 2. %

_______ c. Division frame 3. :

_______ d. Ratio symbol 4. )‾‾‾

_______ e. Minus sign (subtraction) 5. =

_______ f. Percent symbol 6. x

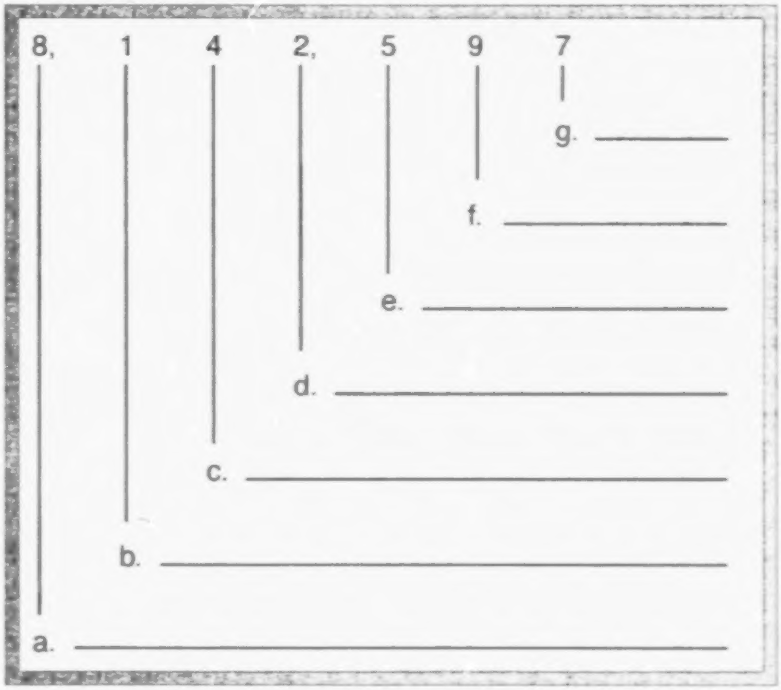
_______ g. Times sign (multiplication) 7. −

_______ h. Decimal point 8. ÷

_______ i. Division sign 9. +

**OBJECTIVE 3**

Label the place values in the whole number below.



**OBJECTIVE 4** Add whole numbers to solve the following problems.

a. $\begin{array}{r} 2 \\ \underline{+\,9} \end{array}$ b. $\begin{array}{r} 5 \\ 7 \\ \underline{+\,8} \end{array}$ c. $\begin{array}{r} 12 \\ 17 \\ \underline{+\,99} \end{array}$ d. $\begin{array}{r} 142 \\ 759 \\ \underline{+\,896} \end{array}$ e. $\begin{array}{r} 2345 \\ 9764 \\ \underline{+\,8976} \end{array}$

**OBJECTIVE 5** Subtract whole numbers to solve the following problems.

a. $\begin{array}{r} 9 \\ \underline{-\,7} \end{array}$ b. $\begin{array}{r} 35 \\ \underline{-\,9} \end{array}$ c. $\begin{array}{r} 481 \\ \underline{-\,79} \end{array}$ d. $\begin{array}{r} 684 \\ \underline{-\,342} \end{array}$ e. $\begin{array}{r} 9867 \\ \underline{-\,8748} \end{array}$

**OBJECTIVE 6** Multiply whole numbers to solve the following problems.

a. $\begin{array}{r} 7 \\ \underline{\times\,5} \end{array}$ b. $\begin{array}{r} 68 \\ \underline{\times\,9} \end{array}$ c. $\begin{array}{r} 735 \\ \underline{\times\,68} \end{array}$ d. $\begin{array}{r} 649 \\ \underline{\times 537} \end{array}$ e. $\begin{array}{r} 8673 \\ \underline{\times\,642} \end{array}$

**OBJECTIVE 7** Divide whole numbers to solve the following problems.

a. $4\overline{)48}$ b. $16\overline{)64}$ c. $38\overline{)608}$

d. $421\overline{)842}$ e. $317\overline{)4569}$ f. $530\overline{)80960}$

**OBJECTIVE 8** Distinguish among types of fractions. Write a "P" in the blanks before the proper fractions, an "I" before improper fractions, and an "M" before mixed numbers.

_____ a. 1/2 _____ e. 5 3/16 _____ i. 1/4

_____ b. 8 3/4 _____ f. 10/32 _____ j. 99/1

_____ c. 8/8 _____ g. 2/8

_____ d. 15 3/8 _____ h. 6 1/2

**OBJECTIVE 9**

Reduce the following fractions to lowest terms. Write your answers in the blanks.

_____ a. 4/8
_____ b. 8/16
_____ c. 7/16
_____ d. 8/32
_____ e. 12/32
_____ f. 4/16
_____ g. 2/16
_____ h. 8/64
_____ i. 12/16
_____ j. 31/32

**OBJECTIVE 10**

Convert the following fractions and mixed numbers.

a. Convert to improper fractions. Reduce to lowest terms if possible. Write your answers in the blanks.

_____ (1) 3 1/2
_____ (2) 4 2/4
_____ (3) 3 6/8
_____ (4) 12 4/8
_____ (5) 13 13/32

b. Convert the following improper fractions to mixed numbers. Reduce answers to lowest terms. Write your answers in the blanks.

_____ (1) 47/8
_____ (2) 21/9
_____ (3) 108/23
_____ (4) 54/5
_____ (5) 112/7

**OBJECTIVE 11**

Add fractions to solve the following problems. Convert to mixed numbers if necessary, and reduce to lowest terms. Write your answers in the blanks.

_____ a. 1/8 + 5/8
_____ b. 1/16 + 15/16
_____ c. 2/4 + 3/4
_____ d. 1/2 + 4/8
_____ e. 4/8 + 2/4
_____ f. 7/8 + 6/16
_____ g. 2 1/8 + 7 1/4
_____ h. 3 2/4 + 16 1/8
_____ i. 4 2/4 + 8 2/8
_____ j. 5 1/8 + 6 2/16

**OBJECTIVE 12**

Subtract fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks.

_____ a. $4/8 - 3/8$

_____ b. $6/8 - 2/8$

_____ c. $9/16 - 4/16$

_____ d. $3/8 - 1/4$

_____ e. $3/8 - 1/8$

_____ f. $14/16 - 7/8$

_____ g. $2\ 3/4 - 1\ 1/4$

_____ h. $6\ 1/8 - 2\ 1/2$

_____ i. $9\ 2/4 - 4\ 1/2$

_____ j. $12\ 6/8 - 7\ 1/8$

**OBJECTIVE 13**

Multiply fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks.

_____ a. $1/2 \times 3/4$

_____ b. $3/4 \times 3/8$

_____ c. $3/2 \times 1/6$

_____ d. $3/4 \times 6\ 1/2$

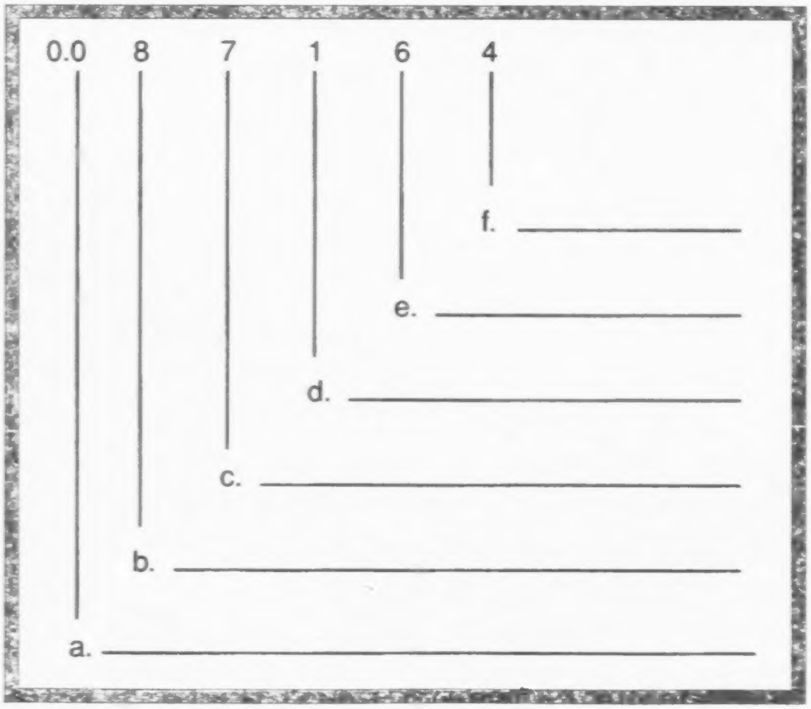
_____ e. $6\ 3/4 \times 8\ 3/4$

_____ f. $7\ 1/8 \times 1\ 1/2$

_____ g. $77/16 \times 5$

**OBJECTIVE 14**

Label the place values in the decimal number below.



**OBJECTIVE 15**

Add decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

_____ a. 3.5 + 5.1 + 7

_____ b. 3.4 + 0.206 + 1.74

_____ c. \$6.86 + \$5.05 + \$7.90 + \$.82

_____ d. 57.78 + 0.22 + 0.003 + 74

_____ e. 6319 + 95.12 + 0.0713 + 321.07

**OBJECTIVE 16**

Subtract decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

_____ a. \$6.10 – \$2.20

_____ b. \$5.40 – \$2.32

_____ c. \$7.38 – \$.63

_____ d. 0.835325 – 0.25

_____ e. 0.609375 – 0.359375

**Objective 17**

Multiply decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

_____ a. 2.6 x 4.7

_____ b. 0.119 x 0.05

_____ c. 9 x 0.08

_____ d. 7.392 x 92.07

_____ e. 9.5 x 0.76

**Objective 18**

Divide decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

_____ a. 5.32 ÷ 0.4

_____ b. 83.4 ÷ 0.6

_____ c. 7.75 ÷ 0.25

_____ d. 0.921 ÷ 0.3

_____ e. 0.0225 ÷ 0.15

_____ f. 24 ÷ 0.2

_____ g. 54 ÷ 0.09

_____ h. 63 ÷ 0.007

_____ i. 812 ÷ 0.058

_____ j. 4125 ÷ 0.040

**OBJECTIVE 19**

a. Convert the following decimal fractions to common fractions. Write your answers in the blanks.

_____ (1) .6

_____ (2) .55

_____ (3) .09

_____ (4) .650

_____ (5) .925

b. Convert the following percentages to fractions and decimal numbers. Write your answers in the blanks.

| Fraction | Decimal | |
|---|---|---|
| __________ | __________ | (1) 12% |
| __________ | __________ | (2) 30% |
| __________ | __________ | (3) 45% |
| __________ | __________ | (4) 72% |
| __________ | __________ | (5) 250% |

**OBJECTIVE 20**

Solve the following percentage problems. Write your answers in the blanks.

_____ a. If a surgeon paid a private scrub $150.00, which is 87 percent of her salary, how much more money would the scrub have coming?

_____ b. If 12 percent of the latex exam gloves are stolen, how many boxes of gloves will be left of the 2100 boxes in storage?

_____ c. If the hospital bought $24,000 worth of equipment and sold it for $30,000, what was the percentage of profit?

**OBJECTIVE 21**

Convert Roman numerals to Arabic numerals. Write your answers in the blanks.

_____ a. ss
_____ b. LXIV
_____ c. M
_____ d. IX
_____ e. XXIII
_____ f. CL
_____ g. XXX
_____ h. VI

***Permission to duplicate this test is granted.**

# Introduction to Surgical Technology
# Section D: Pharmacology
# Module 1-D: Basic Math

## Answers to Written Test

**OBJECTIVE 1**

a. 7
b. 12
c. 1
d. 11
e. 8
f. 6
g. 2
h. 4
i. 13
j. 3
k. 10
l. 9
m. 5

**OBJECTIVE 2**

a. 9
b. 5
c. 4
d. 3
e. 7
f. 2
g. 6
h. 1
i. 8

**OBJECTIVE 3**

a. Millions
b. Hundred thousands
c. Ten thousands
d. Thousands
e. Hundreds
f. Tens
g. Units

**OBJECTIVE 4**

a. 11
b. 20
c. 128
d. 1,797
e. 21,085

**OBJECTIVE 5**

a. 2
b. 26
c. 402
d. 342
e. 1,119

**OBJECTIVE 6**

a. 35
b. 612
c. 49,980
d. 348,513
e. 5,568,066

**OBJECTIVE 7**

a. 12
b. 4
c. 16
d. 2
e. 14, R131
f. 152, R400

**OBJECTIVE 8**

a. P
b. M
c. I
d. M
e. M
f. P
g. P
h. M
i. P
j. I

**OBJECTIVE 9**

a. 1/2
b. 1/2
c. 7/16
d. 1/4
e. 3/8
f. 1/4
g. 1/8
h. 1/8
i. 3/4
j. 31/32

## Module 1-D: Basic Math

| | |
|---|---|
| **OBJECTIVE 10** | a. (1) 7/2 (3) 15/4 (5) 429/32<br>(2) 9/2 (4) 25/2<br>b. (1) 5 7/8 (3) 4 16/23 (5) 16<br>(2) 2 1/3 (4) 10 4/5 |
| **OBJECTIVE 11** | a. 3/4 c. 1 1/4 e. 1 g. 9 3/8 i. 12 3/4<br>b. 1 d. 1 f. 1 1/4 h. 19 5/8 j. 11 1/4 |
| **OBJECTIVE 12** | a. 1/8 c. 5/16 e. 1/4 g. 1 1/2 i. 5<br>b. 1/2 d. 1/8 f. 0 h. 3 5/8 j. 5 5/8 |
| **OBJECTIVE 13** | a. 3/8 c. 1/4 e. 59 1/16 g. 24 1/16<br>b. 9/32 d. 4 7/8 f. 10 11/16 |
| **OBJECTIVE 14** | a. Tenths<br>b. Hundredths<br>c. Thousandths<br>d. Ten thousandths<br>e. Hundred thousandths<br>f. Millionths |
| **OBJECTIVE 15** | a. 15.6 c. $20.63 e. 6735.2613<br>b. 5.346 d. 132.003 |
| **OBJECTIVE 16** | a. $3.90 c. $6.75 e. 0.25<br>b. $3.08 d. 0.585325 |
| **OBJECTIVE 17** | a. 12.22 c. 0.72 e. 7.22<br>b. 0.00595 d. 680.58144 |
| **OBJECTIVE 18** | a. 13.3 c. 31 e. 0.15 g. 600 i. 14,000<br>b. 139 d. 3.07 f. 120 h. 9,000 j. 103,125 |
| **OBJECTIVE 19** | a. (1) 3/5 (3) 9/100 (5) 37/40<br>(2) 11/20 (4) 13/20<br>b. (1) 3/25; 0.12 (3) 9/20; 0.45 (5) 2 1/2; 2.50<br>(2) 3/10; 0.30 (4) 18/25; 0.72 |
| **OBJECTIVE 20** | a. $22.41<br>b. 1848 pairs<br>c. 20 percent |
| **OBJECTIVE 21** | a. 1/2 c. 1000 e. 23 g. 30<br>b. 64 d. 9 f. 150 h. 6 |

## Answers to Assignment Sheets

### Assignment Sheet 1

a.

1. 11
2. 16
3. 13
4. 23
5. 108
6. 88
7. 242
8. 1,538
9. 1,917
10. 16,430

b.

1. 20
2. 11
3. 331
4. $751
5. 40
6. 41
7. 75
8. 423
9. 135
10. 38

### Assignment Sheet 2

a.

1. 4
2. 7
3. 53
4. 406
5. 424
6. 283
7. 1,175
8. 1,810
9. 51,450
10. 89,722

b.

1. 11
2. 12
3. 22
4. 948
5. 28
6. 142
7. 44
8. 8
9. 350
10. 4750

### Assignment Sheet 3

a.

1. 42
2. 72
3. 324
4. 2,884
5. 8,410
6. 2,028
7. 21,291
8. 165,478
9. 503,605
10. 5,458,852

b.

1. 16
2. 256
3. 24
4. 69
5. 320
6. $270
7. 225
8. 400
9. 1,536
10. 98

## Assignment Sheet 4

a.

1. 4
2. 8
3. 91
4. 312
5. 3
6. 3
7. 62, R4
8. 2, R78
9. 1, R787
10. 3, R85

b.

1. 10
2. $11
3. 11
4. 23
5. $3,333.33
6. 5

## Assignment Sheet 5

a. 1/2
b. 1/2
c. 1
d. 1/4
e. 1/4
f. 3/8
g. 1/2
h. 1/2
i. 3/4
j. 1/2

## Assignment Sheet 6

a.

1. P
2. M
3. I
4. M
5. P
6. I
7. I
8. M
9. I
10. M
11. M
12. I
13. I
14. P
15. M

b.

1. 13/4
2. 9/2
3. 31/4
4. 17/2
5. 49/8
6. 11/2
7. 17/4
8. 17/2
9. 37/4
10. 33/2

c.

1. 1 3/4
2. 4 1/2
3. 1 1/2
4. 1 7/8
5. 1 3/16
6. 1 3/8
7. 2 11/32
8. 2 1/2
9. 3 3/4
10. 2 1/16

## Assignment Sheet 7

a.

1. 3/4
2. 1 1/2
3. 1/2
4. 1
5. 1 3/16
6. 25/32
7. 29/32
8. 1 1/4
9. 1 5/16
10. 1 25/32

b.

1. 14 3/4
2. 7 3/4
3. 7 3/16
4. 19 5/8
5. 13 1/16
6. 60 1/16
7. 6 13/16
8. 3 1/4
9. 17 1/16

### Assignment Sheet 8

a.

1. 9/16
2. 5/8
3. 3/16
4. 5/32
5. 3/4
6. 9/16
7. 1/16
8. 3/8
9. 17/32
10. 1/2

b.

1. 3 1/4
2. 6 1/16
3. 31 19/32
4. 174 1/5
5. 11 3/64

c.

1. 2/3
2. 1 5/8
3. 8 1/8
4. 1 11/32
5. 25 11/16
6. 7 1/4
7. 9/16
8. 1 1/16
9. 2/3
10. 38 9/16

d.

1. 2/5
2. 49 15/16
3. 5 2/3
4. 9 1/2
5. 27 1/8
6. 2 1/4
7. 2 1/8
8. 3 5/16
9. 2 1/2
10. 3 3/16

e.

1. 1/8
2. 1
3. 2 7/8
4. 10
5. 1 3/8
6. 6 11/20
7. 3 3/4
8. 8 5/8

### Assignment Sheet 9

a.

1. 3/8
2. 3 3/8
3. 7/12
4. 1/24
5. 15/128
6. 3 1/4
7. 1 1/2
8. 16 27/32

b.

1. 1/4 gallon
2. 74 packages of suture
3. 4 1/3 pounds

## Assignment Sheet 10

a.

1. Tenths
2. Hundredths
3. Ten thousandths
4. Ten thousandths
5. Thousandths

b.

1. Hundredths
2. Ten thousandths
3. Tenths
4. Thousandths
5. Hundredths

c.

1. 46.3$\underline{8}$26
2. 35.003$\underline{8}$
3. 148.$\underline{2}$96
4. 6758.2$\underline{3}$
5. 91.40$\underline{8}$2
6. 2$\underline{0}$4.37
7. 1$\underline{4}$.0079
8. 208.0$\underline{9}$7
9. 5.23$\underline{9}$81
10. 502.$\underline{9}$67
11. 5230.86$\underline{7}$
12. 58$\underline{7}$.029
13. 0.2$\underline{9}$8
14. 3$\underline{2}$9.768
15. 52.69$\underline{4}$
16. 498.$\underline{2}$76
17. 0.529$\underline{6}$
18. 468.5$\underline{3}$9
19. 324.$\underline{0}$6
20. 56$\underline{7}$.8

d.

1.
$$\begin{array}{r} 0.024 \\ \underline{+\ 0.165} \\ 0.189 \end{array}$$

2.
$$\begin{array}{r} 87.3 \\ \underline{+\ 370.0} \\ 457.3 \end{array}$$

3.
$$\begin{array}{r} 15.127\phantom{0} \\ 3.4\phantom{000} \\ .0091 \\ \underline{+\ 236.87\phantom{00}} \\ 255.4061 \end{array}$$

4.
$$\begin{array}{r} 195.7\phantom{00} \\ 83.0\phantom{00} \\ \underline{+\ \ 9.006} \\ 287.706 \end{array}$$

5.
$$\begin{array}{r} .5280 \\ 435.\phantom{0000} \\ 179.50\phantom{00} \\ \underline{+\ \ 1.9\phantom{000}} \\ 616.9280 \end{array}$$

e.

1. \$39.00
2. \$74.33
3. 23.9
4. 19.2
5. \$16,000.26

## Assignment Sheet 11

a.

1. 351.98
2. 547.144
3. 141.013
4. 508.16
5. $749.25
6. $4.15
7. 670.4
8. 4,107.34
9. $2.47
10. $197.45

b.

1. $3317.32
2. 14.5
3. 2.84
4. 40.5
5. 27.5

## Assignment Sheet 12

a.

1. 8.184
2. 39.6
3. 1.1475
4. 297.5
5. 100.32
6. 6.4584
7. 0.4565
8. 25.38
9. 0.00069
10. 22.6352

b.

1. $337.45
2. $6187.50
3. .28
4. $16.95
5. $18.72
6. 67.2

## Assignment Sheet 13

a.

1. 9
2. 12.4
3. 33
4. 153
5. 1.5
6. 284
7. 0.8
8. 0.5
9. 300
10. .4

b.

1. $8.64
2. 30.3
3. 32
4. $21.60
5. $4.78

## Assignment Sheet 14

a.

1. 0.125
2. 0.25
3. 0.5
4. 0.75
5. 0.625
6. 0.0625
7. 0.09375
8. 0.875
9. 0.5625
10. 0.9375

b.

1. 25%
2. 50%
3. 70%
4. 75%
5. 100%
6. 10%
7. 87.5%
8. 50%
9. 33.3%
10. 62.5%

c.

1. g
2. j
3. d
4. a
5. i
6. b
7. c
8. f
9. h
10. e

d.

1. 63.9
2. 5.93
3. 5.093
4. 5.0093
5. 3.825
6. 38.95
7. 38.095
8. 42.3
9. 402.3
10. 897.00097

e.

1. 1/2
2. 1/4
3. 1/3
4. 9/25
5. 7/25
6. 1/7
7. 21/100
8. 3/4
9. 2/3
10. 7/10

f.

1. .47
2. .15
3. .333
4. .62
5. .75
6. .03
7. .168
8. .09
9. .10
10. .50

**Assignment Sheet 15**

a. All work completed
b. 14%
c. 86, 86%
d. 25%
e. 94%
f. 6, 6%
g. 89%
h. 94%
i. 40%
j. 50%
k. 5%
l. 38%
m. 25%
n. 60%
o. 7%

p.
1. 2.16
2. 0.9
3. 32
4. 50
5. 43.18
6. 17.6
7. 1.03
8. 57
9. 16.4
10. 11.41

q.
1. 12
2. 1
3. $24.00
4. 600

### Assignment Sheet 16

| | | | | |
|---|---|---|---|---|
| a. | 1. | 5 | 6. | 1001 |
| | 2. | 11 | 7. | 36 |
| | 3. | 7 | 8. | 92 |
| | 4. | 80 | 9. | 47 |
| | 5. | 3 | 10. | 164 |

### Assignment Sheet 17

| | | | | |
|---|---|---|---|---|
| a. | 1. | 1/4″ | 6. | 2 1/2″ |
| | 2. | 1/2″ | 7. | 1 1/4″ |
| | 3. | 1 1/4″ | 8. | 2 1/2″ |
| | 4. | 1 3/4″ | 9. | 1 1/2″ |
| | 5. | 1 1/4″ | 10. | 4″ |
| b. | 1. | 3/8″ | 6. | 2 3/4″ |
| | 2. | 1/4″ | 7. | 1/2″ |
| | 3. | 1 1/8″ | 8. | 2″ |
| | 4. | 3/4″ | 9. | 4 1/4″ |
| | 5. | 1 1/2″ | 10. | 2 3/8″ |
| c. | 1. | 15/16″ | 6. | 3 5/16″ |
| | 2. | 1/2″ | 7. | 1 1/2″ |
| | 3. | 1 13/16″ | 8. | 2 5/8″ |
| | 4. | 3/4″ | 9. | 4 1/4″ |
| | 5. | 1 11/16″ | 10. | 1 5/8″ |
| d. | 1. | 25/32″ | 6. | 1 1/2″ |
| | 2. | 1 5/32″ | 7. | 1 3/16″ |
| | 3. | 3/8″ | 8. | 2 13/16″ |
| | 4. | 1 27/32″ | 9. | 4 9/32″ |
| | 5. | 1 9/16″ | 10. | 1 15/16″ |

# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

### Module 2-D: Weights and Measures

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 2-D: Weights and Measures

### Module Contents

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# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 2-D: Weights and Measures

## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module" and "Suggested Supplemental Resources" for more information.
- Review teacher supplements and make copies of any that will be provided for each student.
- Make a transparency from the transparency master.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the student supplements. These could be used as homework assignments, daily practice exercises, or quizzes. Explain to students how you plan to evaluate the supplements, if at all.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

- Provide examples of surgical supplies and drugs that are noted with metric weights or measures. Have students examine the packages to identify the weights and measures information. Hands-on experience reinforces tactile learning and helps students see the importance of weights and measures to surgery.
- Have students practice using the metric system by converting their weights and heights to metric equivalents.
- Discuss times when the metric system is used, when an alternative system (such as household) may be used, and when an alternative is unacceptable.
- Discuss the apothecary system of weights and capacities used by pharmacists and how this system applies to surgical technologists.
  - — Teacher Supplement 1 and 2 provide more information and an optional activity on the apothecary system.
  - — Make copies for your students as needed.
  - — Answers to the activity are on the back of Teacher Supplement 2.
- Use Teacher Supplement 3 as a master listing of conversion charts. Enlarge and post in the classroom.
- Student Supplements 1–4 give students practice exercises using various conversion charts.

**RESOURCES USED IN DEVELOPING THIS MODULE**

- Asperheim, Mary Kaye. *Pharmacology: An Introductory Text.* 9th ed. Philadelphia: W.B. Saunders Co., 2002.
- Clayton, Bruce D. *Basic Pharmacology for Nurses.* 12th ed. St. Louis: Mosby, Inc., 2001.
- *Core Curriculum for Surgical Technology.* 5th ed. Centennial, CO: Association of Surgical Technologists, 2002.
- Cornett, Emily F., and Dorothy Blume. *Dosage and Solutions.* Philadelphia: F.A. Davis Company, 1991.

- Fuller, Joanna R. *Surgical Technology—Principles and Practice*. 3rd ed. Philadelphia: W. B. Saunders Co., 1994.
- Hitner, Henry, and Barbara Nagle. *Basic Pharmacology*. 4th ed. New York: Glencoe McGraw-Hill, 1999.
- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Reiss, Barry S., and Mary E. Evans. *Pharmacological Aspects of Nursing Care*. 6th ed. New York: Delmar, 2001.

# Teacher Supplement 1—Apothecary System

## 1. Characteristics of apothecary system

- Based on weights and volumes of simple items such as a grain of wheat, a small stone, or a container of liquid. Began in ancient Greek and Roman times.
- Used chiefly by pharmacists.

  ✔ **NOTE:** There are some pharmacologic agents that you will be handling that are measured according to this system.

- Roman numerals indicate quantities and are preceded by symbols or abbreviations.

  Examples: One and one-half drams is written ʒ iss

  Three ounces is written ℥ iii

- Basic unit of weight is the grain.
- Basic unit of fluid measure is the minim.

## 2. Apothecaries' equivalents of weight and capacity

- Weight
  - — 60 grains = 1 dram
  - — 8 drams = 1 ounce
  - — 12 ounces = 1 pound
- Capacity
  - — 60 minims = 1 fluid dram (f ʒ i)
  - — 8 fluid drams = 1 fluid ounce (f ℥ i)
  - — 16 fluid ounces = 1 pint
  - — 2 pints = 1 quart
  - — 4 quarts = 1 gallon

***Permission to duplicate this supplement is granted.**

## Teacher Supplement 2—Apothecary Activity (Optional)

Name ______________________________ Date ______________

**DIRECTIONS** State the equivalents for the following amounts.

1. 1 dram = ______________________ grains
2. 1 dram = ______________________ ounces
3. 1 ounce = ______________________ drams
4. 1 pound = ______________________ ounces
5. 4 drams = ______________________ ounces
6. 1/2 ounce = ______________________ drams
7. 1 fluid ounce = ______________________ fluid drams
8. 1 fluid dram = ______________________ minims
9. 1 pint = ______________________ fluid ounces
10. 6 fluid drams = ______________________ fluid ounces

***Permission to duplicate this supplement is granted.**

# Teacher Supplement 2

**ANSWER SHEET**

1. 1 dram = 60 grains
2. 1 dram = 1/8 ounce
3. 1 ounce = 8 drams
4. 1 pound = 12 ounces
5. 4 drams = 1/2 ounce
6. 1/2 ounce = 4 drams
7. 1 fluid ounce = 8 fluid drams
8. 1 fluid dram = 60 minims
9. 1 pint = 16 fluid ounces
10. 6 fluid drams = 3/4 fluid ounce

## Teacher Supplement 3— Conversion Charts

| WEIGHT CONVERSION CHART | | |
|---|---|---|
| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU MULTIPLY BY |
| Ounces | Grams (or mL) | 30. |
| Grams (or mL) | Ounces | 0.035 |
| Pounds | Kilograms | 0.45 |
| Kilograms | Pounds | 2.2 |
| Grains | Grams (or mL) | 0.065 |
| Grams (or mL) | Grains | 15. |
| Drams | Grams (or mL) | 4. |
| Grams (or mL) | Drams | 0.257 |
| Grams (or mL) | Milligrams | 1000. |
| Milligrams | Grams (or mL) | 0.001 |

| CAPACITY CONVERSION CHART | | |
|---|---|---|
| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU MULTIPLY BY |
| Liters | Gallons | 0.26 |
| Gallons | Liters | 3.8 |
| Liters | Quarts | 1.06 |
| Quarts | Liters | 0.95 |
| Liters | Pints | 2.1 |
| Pints | Liters | 0.47 |
| Fluid ounces | Milliliters (or cc) | 30. |
| Milliliters (or cc) | Fluid ounces | 0.034 |
| Minims | Milliliters (or cc) | 0.06 |
| Milliliters (or cc) | Minims | 16.7 |
| Fluid ounces | Fluid drams | 8.0 |
| Fluid drams | Fluid ounces | 0.125 |
| Fluid drams | Milliliters (or cc) | 4. |
| Milliliters (or cc) | Fluid drams | 0.27 |
| Liter | Milliliter (or cc) | 1000. |
| Milliliter | Liter | 0.001 |

## LENGTH CONVERSION CHART

| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU MULTIPLY BY |
|---|---|---|
| Inches | Millimeters | 25.4 |
| Millimeters | Inches | 0.04 |
| Inches | Centimeters | 2.54 |
| Centimeters | Inches | 0.4 |
| Inches | Meters | 0.0254 |
| Meters | Inches | 39.37 |
| Feet | Meters | 0.305 |
| Meters | Feet | 3.28 |
| Meters | Centimeters | 100. |
| Meters | Millimeters | 1000. |
| Millimeters | Meters | 0.001 |
| Millimeters | Centimeters | 0.01 |
| Centimeters | Meters | 0.01 |
| Centimeters | Millimeters | 10. |

## TEMPERATURE CONVERSION CHART

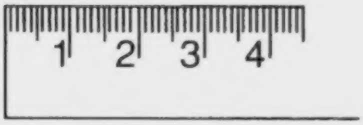
| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU USE |
|---|---|---|
| Degrees Fahrenheit | Degrees Celsius | $5/9\,(F^\circ - 32) = C^\circ$ |
| Degrees Celsius | Degrees Fahrenheit | $9/5\,(C^\circ) + 32 = F^\circ$ |

***Permission to duplicate this supplement is granted.**

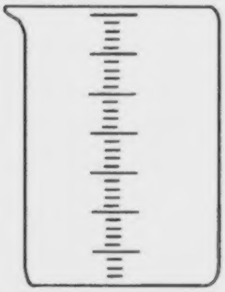
Introduction to Surgical Technology
Section D: Pharmacology
Module 2-D: Weights and Measures

# Basic Units of Metric System

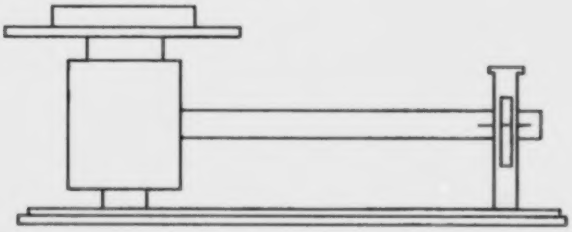
1. Meter Length



2. Liter Capacity



3. Gram Weight



## Written Test

Name ______________________________

Date ______________________ Score ______________________

**OBJECTIVE 1**

Select true statements concerning the metric system of measurement by placing an "X" in the blanks next to the true statements.

_______ a. Invented by the United States in the late eighteenth century.

_______ b. Based on the decimal system; uses units and multiples of tens.

_______ c. Uses abbreviations and Arabic numerals for written measurements of medication.

_______ d. One thousand milliliters is written 1000 ml or 1000 cc.

_______ e. Basic unit of weight is the grain.

_______ f. Basic units of measurement include meter, liter, and gram.

_______ g. Basic unit of fluid measure is the minim.

**OBJECTIVE 2**

Match metric prefixes on the right with their correct amounts.

_______ a. One-millionth — 0.000001
_______ b. One-thousandth — 0.001
_______ c. One-hundredth — 0.01
_______ d. One-tenth — 0.1
_______ e. One — 1.0
_______ f. Ten — 10.0
_______ g. One hundred — 100.0
_______ h. One thousand — 1000.0

1. Hecto
2. Centi
3. Unit
4. Kilo
5. Milli
6. Deci
7. Deka
8. Micro

## Module 2-D: Weights and Measures

**OBJECTIVE 3** State metric equivalents of weight, capacity, and length.

a. 1 gram = ____________________ milligrams

b. 1 kilogram = ____________________ pounds

c. 1 kilogram = ____________________ grams

d. 1 ounce = ____________________ grams

e. 1 ____________________ = 1000 milliliters

f. 1000 liters = 1 ____________________

g. 1 liter = ____________________ cubic centimeters or milliliters

h. 1 fluid ounce = 8 fluid drams = ____________________ cubic centimeters or milliliters

i. 1 fluid dram = ____________________ cubic centimeters

j. 1 meter = ____________________ centimeters

k. 1 yard = ____________________ inches

l. 1 inch = ____________________ centimeters

**OBJECTIVE 4** List one advantage of the metric system.

________________________________________________________________

________________________________________________________________

**OBJECTIVE 5** State the abbreviations for the following metric weights and measures.

a. Gram = __________

b. Milligram = __________

c. Kilogram = __________

d. Liter = __________

e. Milliliter = __________

f. Cubic centimeter = __________

g. Meter = __________

h. Millimeter = __________

i. Centimeter = __________

**OBJECTIVE 6** Distinguish between systems for measuring temperature by placing an "X" next to the statements associated with the Fahrenheit system.

_______ a. Water freezes at 0°

_______ b. Water freezes at 32°

_______ c. Water boils at 100°

_______ d. Water boils at 212°

**OBJECTIVE 7** Write the correct abbreviations pertaining to the handling of medications next to their meanings.

a. Intramuscular ________________________

b. Solution ________________________

c. Mouth ________________________

d. Of each ________________________

e. As needed ________________________

f. Without ________________________

g. With ________________________

h. Intravenous ________________________

i. One-half ________________________

j. At once ________________________

***Permission to duplicate this test is granted.**

## Answers to Written Test

**Objective 1** b, c, d, f

**Objective 2**

- a. 8
- b. 5
- c. 2
- d. 6
- e. 3
- f. 7
- g. 1
- h. 4

**Objective 3**

- a. 1000
- b. 2.2
- c. 1000
- d. 30
- e. Liter
- f. Kiloliter
- g. 1000
- h. 30
- i. 4
- j. 100
- k. 36
- l. 2.54

**Objective 4** Any one of the following:

- a. All standard units of weight and measurement bear a simple relation to the fundamental unit, the meter.
- b. The prefixes deci, centi, milli, deka, hecto, and kilo have a numerical significance and have other applications in our language that make them readily understood.
- c. The uniform decimal scale of relation between the successive units makes the use of decimal notation possible.

**Objective 5**

- a. gm
- b. mg
- c. kg
- d. L
- e. mL
- f. cc
- g. m
- h. mm
- i. cm

**Objective 6** b, d

**Objective 7**

- a. IM
- b. sol
- c. os
- d. $\overline{\text{aa}}$
- e. prn
- f. $\overline{\text{s}}$
- g. $\overline{\text{c}}$
- h. IV
- i. $\overline{\text{ss}}$
- j. stat

## Answers to Student Supplements

### Student Supplement 1

✔ **NOTE:** The variations in answers for 6, 7 and 8 depend upon whether students multiply by 0.45 or divide by 2.2.

1. 20 gm
2. 3.855 dr
3. 12000 mg
4. 150 gm
5. 45 gr
6. 64.8 kg or 65.5 kg
7. 99 kg or 100 kg
8. 83.25 kg or 84.1 kg
9. 136.4 lb
10. 228.8 lb
11. 2.275 oz
12. 0.12 gm
13. 154 lb

### Student Supplement 2

1. 360 mL
2. 16 fl dr
3. 10.5 pt
4. 500 mL
5. 28 cc
6. 20 cc
7. .68 fl oz
8. .81 fl dr
9. 8 cc
10. 2 cc
11. .52 gal
12. 4.75 L
13. 11.4 L
14. 7.42 qt
15. .7 L
16. 4.2 pt

### Student Supplement 3

1. 472.44″
2. .1525 m
3. 101.6 mm
4. 3.2″
5. 3.05 m
6. 1.6774 m
7. 1.83 m
8. 71″ or 5′ 11″
9. 1.016 m
10. 1.8808 m

### Student Supplement 4

1. 53.6°F
2. 86°F
3. 224.6°F
4. 32°F
5. 41°F
6. 26.67°C
7. 37.78°C
8. 0°C
9. 15°C
10. 38.89°C

## Answers to Assignment Sheets

**Assignment Sheet 1**

WEIGHT

1. 2.2
2. 1000
3. 15
4. 750
5. 10
6. 500
7. 0.1
8. 0.025
9. 1
10. .065
11. 65
12. 30
13. 110
14. 220
15. 30

CAPACITY

16. 1
17. 15
18. 30
19. 8
20. 4
21. 1000
22. 1.06
23. .5
24. 750
25. 2

LENGTH

26. 1000
27. 2.54
28. 152.4
29. .1
30. 1000
31. 1.778
32. 1000
33. 12
34. .610

**Assignment Sheet 2**

1. 522 gm
2. 15 mg
3. 12.5 cc
4. 2.5 gm
5. 150 kg
6. 6 m
7. 2 L
8. 5 cm
9. 25 mm
10. 1 gm

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 2-D: Weights and Measures

## Module Review

Name ______________________________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 7

1. What does the abbreviation "OD" mean?
   - a. left eye
   - b. right eye
   - c. both eyes
   - d. neither eye

Objective 5

2. Which of the following is the correct abbreviation for gram?
   - a. G
   - b. g
   - c. gm
   - d. GM

Objective 3

3. One cubic centimeter and one ______________ are equal in practice.
   - a. gallon
   - b. liter
   - c. quart
   - d. milliliter

Objective 6

4. Water boils at _________ Fahrenheit.
   - a. 0°
   - b. 32°
   - c. 212°
   - d. 100°

Objective 2

5. The prefix deka stands for ____________________.

   a. 0.000001

   b. 0.001

   c. .01

   d. 10.

Objective 1

6. When was the metric system invented?

   a. nineteenth century

   b. eighteenth century

   c. twentieth century

   d. seventeenth century

Objective 3

7. One gram equals _______________ milligrams.

   a. 10

   b. 100

   c. 1000

   d. 10,000

Objective 7

8. What does the abbreviation "Rx" mean?

   a. take

   b. as needed

   c. spirit

   d. tincture

Objective 1

9. The metric system uses units and multiples of ____________.

   a. hundreds

   b. thousands

   c. ones

   d. tens

Objective 3

10. 36 inches equals ____________.
    - a. 1 yard
    - b. 3 feet
    - c. 0.9144 meters
    - d. All of the above

Objective 7

11. What does the abbreviation "prn" mean?
    - a. take
    - b. as needed
    - c. spirit
    - d. tincture

Objective 1

12. A liter is the volume occupied by one kilogram of water at ________ centigrade.
    - a. 2°
    - b. 3°
    - c. 4°
    - d. 5°

Objective 4

13. All standard units of weight and measurement bear a simple relation to the fundamental unit, the __________________.
    - a. meter
    - b. pound
    - c. ounce
    - d. mile

Objective 2

14. The prefix micro stands for ___________________.
    - a. 0.000001
    - b. 0.001
    - c. .01
    - d. 100.

Objective 7

15. What is the abbreviation for "drops"?

a. gtt

b. drp

c. dr

d. gtp

Objective 6

16. Water boils at __________ Celsius.

a. 0°

b. 32°

c. 212°

d. 100°

Objective 2

17. The prefix hecto stands for _________________.

a. 0.000001

b. 0.001

c. .01

d. 100.

Objective 3

18. 1000 liters equals ______________ kiloliter.

a. 1

b. 10

c. 100

d. 1000

Objective 5

19. Which of the following is the correct abbreviation for liter?

a. L

b. l

c. li

d. lt

Objective 1

20. The basic unit of measurement used for weight is ____________.
    a. gram
    b. liter
    c. meter
    d. cup

Objective 3

21. Which of the following is used to measure minute distances such as sizes of bacteria?
    a. centimeter
    b. micron
    c. millimeter
    d. decimeter

Objective 6

22. Water freezes at ________ Fahrenheit.
    a. 0°
    b. 32°
    c. 212°
    d. 100°

Objective 5

23. Which of the following is the correct abbreviation for millimeter?
    a. M
    b. MM
    c. mm
    d. m

Objective 3

24. Eight fluid drams equals ______________.
    a. 1 fluid ounce
    b. 30 cubic centimeters
    c. 4 milliliters
    d. A and B

Objective 7

25. What is the abbreviation for "ointment"?

    a. OT

    b. ol

    c. os

    d. ung

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. b
2. c
3. d
4. c
5. d
6. b
7. c
8. a
9. d
10. d
11. b
12. c
13. a
14. a
15. a
16. d
17. d
18. a
19. a
20. a
21. b
22. b
23. c
24. d
25. d

# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

### Module 3-D: Syringes and Hypodermic Needles

## Module Contents

**COMPONENTS**

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2—Types of Irrigating Syringes . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 11
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Answers to Module Review . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 35

## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheet. Review with students the criteria for evaluation of these activities.
- Discuss and demonstrate the job sheets. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of these activities and the rating scale that will be used to indicate job performance.

EVALUATION

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.

- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheet. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheet for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.

- Evaluate the job sheets. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

  **Sample A**

  4—**Skilled**—Can perform job with no additional training.
  3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
  2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
  1—**Unskilled**—Is familiar with process, but is unable to perform job.
  0—**No exposure**—No information or practice provided during training program.

  **Sample B**

  **Yes**—Can perform job with no additional training.
  **No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.

- Make copies of, give, and evaluate the Module Review.

- Compile the Written Test, assignment-sheet, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.

- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.

- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to introduce students to syringes and hypodermic needles used in the operating room and to develop an understanding of the types of syringes and needles and their applications.

- To introduce this module have on display the various types of syringes, needles, and medication containers discussed in this module.
- Discuss the uses of various types of syringes and types of tips available for each.
- Show examples of large and small hypodermic needles, and discuss their corresponding gauge numbers.
- Invite a guest speaker, such as a nurse or anesthesiologist, to demonstrate the usages of different hypodermic needles.
- Contact syringe and needle manufacturers for current information about their products. They may be able to provide samples of their products and brochures. Emphasize those commonly used in surgery.
- Explore with the students the implications of inaccurately reading syringe calibrations.
- Obtain copies of area hospitals' operating room policies and procedures manuals for preparing, receiving, and administering medications.
- Discuss with the students any guidelines that differ from the information provided in this module.
- Obtain a copy of the latest OSHA guidelines and discuss with the students those guidelines that pertain to the preparation and administration of medications.
- Remind students that injection/aspiration needles are sharps and should be included in all counts.
- Have students wear sterile gloves and/or surgical attire when practicing the job sheets for safety and to better simulate the actual operating room setting.
- Discuss and demonstrate the correct procedure for transferring sterile needles onto the field, and have students practice this procedure.
- Discuss and demonstrate the correct procedure for drawing up medication held by the circulator, and have students practice this procedure while wearing surgical attire.
- Discuss and demonstrate the correct procedures for mixing medications with irrigating fluids, and have students practice this procedure.

**RESOURCES USED IN DEVELOPING THIS MODULE**

- *AORN Standards and Recommended Practices for Perioperative Nursing.* Denver: Association of Operating Room Nursing, Inc., 2002.
- Caruthers, Bob L., and Paul Price, ed. *Surgical Technology for the Surgical Technologist—A Positive Care Approach.* Albany, NY: Delmar, 2001.
- Center for Disease Control. "Guidelines for prevention of Transmission of Human Immunodeficiency Virus and Hepatitis B Virus to Health Care and Public Safety Workers." A response to P>L>100-607, The Health Omnibus Programs Extension Act of 1988.

- Center for Disease Control. "Update: Public Health Service Guidelines for Management of Occupational Exposure to Hepatitis B Virus, Hepatitis C Virus, and Human Immunodeficiency Virus and Recommendations for Post Exposure Prophylaxis." *Morbidity and Mortality Weekly Report*, Volume 50, #RR-1, (June 29, 2001).
- Fuller, Joanna R. *Surgical Technology—Principles and Practice*. 3rd ed. Philadelphia: W. B. Saunders Co., 1994.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery*. 11th ed. St. Louis: Mosby, Inc., 1999.
- National Institute for Occupational Safety and Health. "Preventing Needlestick Injuries in Healthcare Settings," *NIOSH Alert*, Publication No. 2000-108, 1999.
- Occupational Safety and Health Administration. "The OSHA Bloodborne Hazard Standard." Occupational Exposures to Bloodborne Pathogens, 1996.
- Snyder, Katherine and Chris Keegan. *Pharmacology for the Surgical Technologist*. Philadelphia: W.B. Saunders, 1999.
- *Surgical Techniques*. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.

**SUGGESTED WEB SITES***

✔ **NOTE:** The following Web sites offer information concerning syringes, hypodermic needles, and general information about preventing needle sticks in the health care environment.

- http://www.osha-slc.gov/SLTC/bloodbornepathogens/

  The Occupational Safety and Health Administration Web site includes revisions mandated by the Needlestick Safety and Prevention Act and provides information about bloodborne pathogens standards.

- http://www.cdc.gov/health/needlesticks.htm

  The Center for Disease Control Web site provides information on worker protection from bloodborne pathogens and provides information on selecting, evaluating, and using sharps disposal containers.

- http://www.cdc.gov/niosh/2000-135.html

  The National Institute for Occupational Safety and Health (NIOSH) with the Center for Disease Control provides publications on this Web site to inform workers on what they should know about protecting themselves from needlestick injuries as well as information about occupational safety and health topics.

- http://www.aorn.org

  The Association of Operating Room Nurses' (AORN) Web site provides information on standards, recommended practices, and guidelines for surgical hazards, packaging systems, positioning the patient, radiological safety, and maintaining a sterile field—all updated by the Recommended Practices Committee to reflect the latest in perioperative research, practice, and technology.

- http://www.acponline.org/

  The American College of Physicians' Web site provides information on health care hazards such as preventing needle sticks, Universal precautions, and how healthcare workers can keep track of their sharps to prevent deadly accidents.

- http://www.aha.org/

  The American Hospital Association's (AHA) is committed to reducing the number of sharps injuries through their involvement in the development of OSHA's Bloodborne Pathogen Standard—a standard that revolutionized safety for health care workers. The AHA Web site provides detailed information about evaluating safety devices and implementing their use as part of a comprehensive sharps injury prevention program.

- http://www.cdc.gov/mmwr

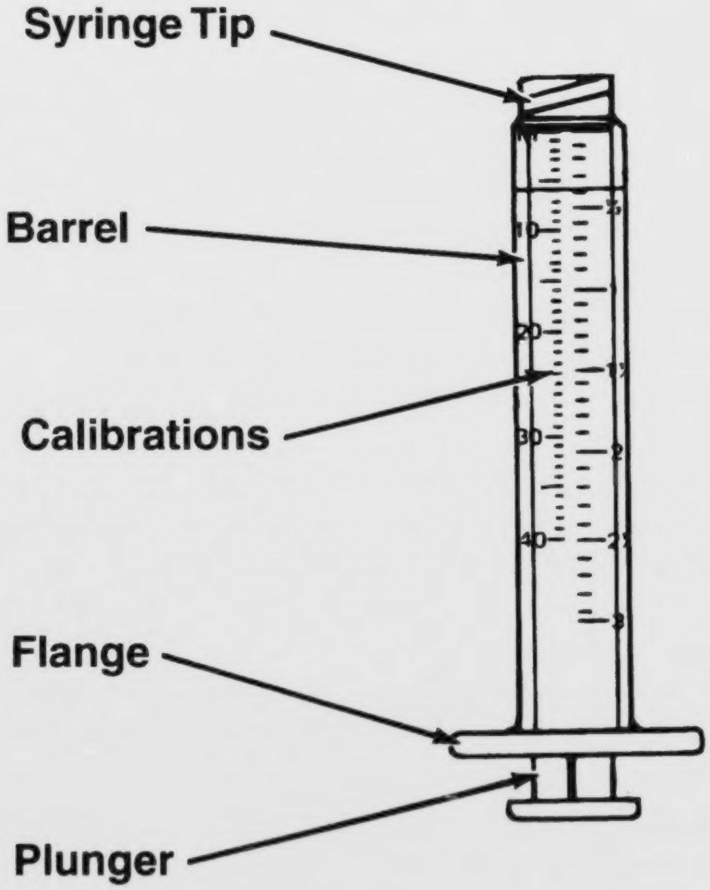
  The Center for Disease Control's Web site provides the *Morbidity and Mortality Weekly Report (MMWR)*. This report contains data on specific diseases as reported by state and territorial health departments and reports on infectious and chronic diseases, environmental hazards, natural or human-generated disasters, occupational diseases and injuries, and intentional and unintentional injuries. Also included are reports on topics of international interest and notices of events of interest to the public health community.

- http://www.jcaho.org/

  The Joint Commission on Accreditation of Healthcare Organizations' (JCAHO) Web site contains the *Sentinel Event Alert* newsletter which provides information on preventing needlestick and sharp injuries. This Web site describes common underlying causes of sharp injuries and suggests steps to prevent occurrences in the future.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

# Parts of a Syringe


Syringe Tip
Barrel
Calibrations
Flange
Plunger
10
20
30
40
½
1
1½
2
2½
3

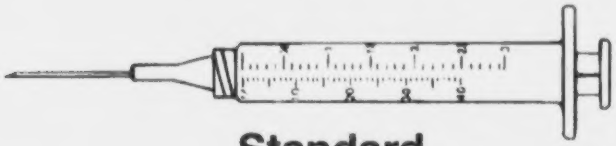
# Types of Irrigating Syringes

**Asepto syringe (two-piece)**

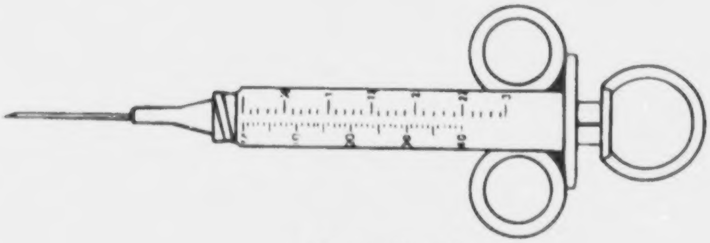
**Toomey syringe**

**Bulb syringe without barrel (one-piece)**

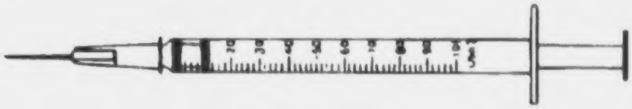
# Types of Syringes



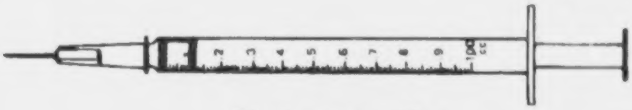
**Standard**



**Control**

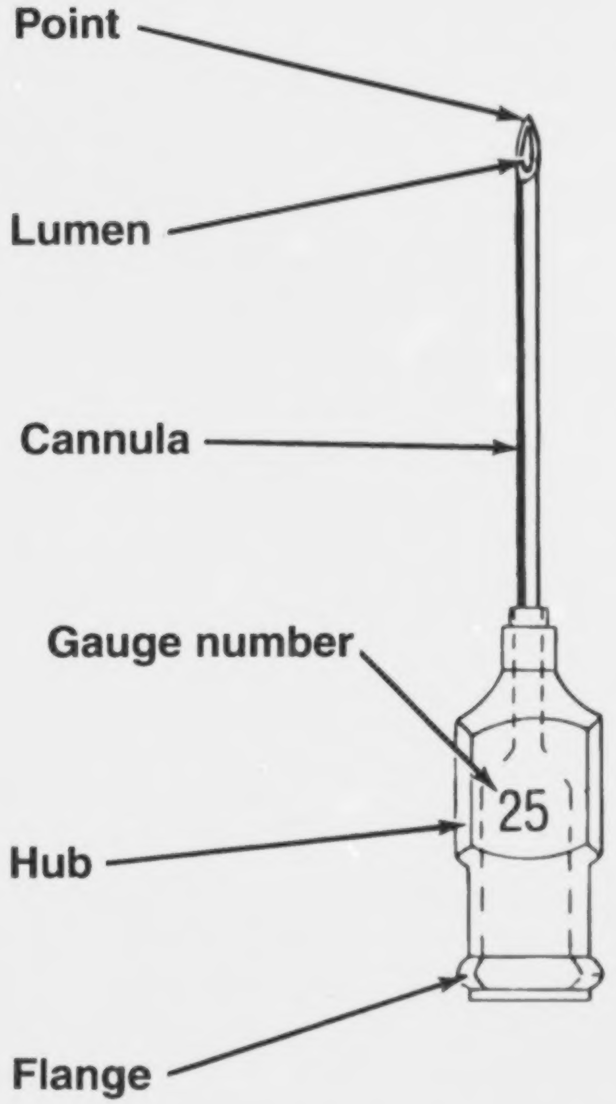


**Insulin**



**Tuberculin**

# Parts of a Hypodermic Needle


Point
Lumen
Cannula
Gauge number
25
Hub
Flange

## Written Test

Name ______________________________

Date ____________________ Score ____________________

**OBJECTIVE 1** Discuss two uses for syringes in the operating room.

a. ______________________________

______________________________

b. ______________________________

______________________________

**OBJECTIVE 2** Select true statements concerning the characteristics of syringes by writing an "X" on the blanks next to the true statements.

_____ a. All basic syringes are calibrated in cubic centimeters (cc).

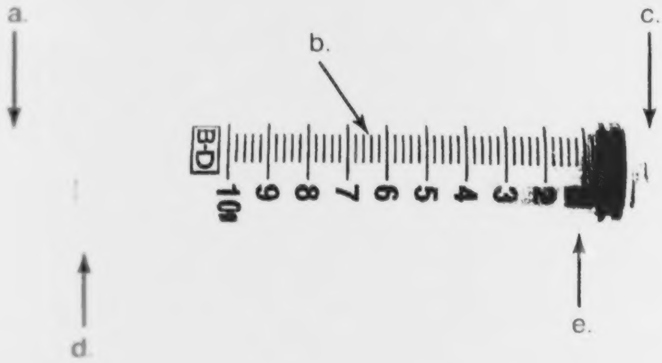
_____ b. Syringes are available in three sizes—1, 25, and 50 cc.

_____ c. Syringes are available in two basic materials—plastic and glass.

_____ d. Syringes for irrigation are used with needles of various sizes.

_____ e. Syringes for injection or aspiration are used without needles.

**OBJECTIVE 3** Identify the parts of a syringe. Write the correct answers in the blanks below.



a. ____________________ b. ____________________

c. ____________________ d. ____________________

e. ____________________

BEST COPY AVAILABLE

**OBJECTIVE 4** Complete statements concerning types of syringes used for irrigation. Write your answers on the blank lines provided in the statements below.

**Bulb with a removable barrel**

a. Is a plastic or __________________ bulb attached to a tapered or blunt end barrel

b. Is used with one-hand control for __________________ during many surgical procedures

c. Is available in various capacity sizes. The largest holds approximately _____ cc.

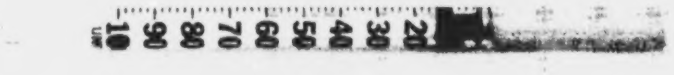
**Bulb without a barrel**

a. Is a __________________ piece bulb that tapers to a blunt end

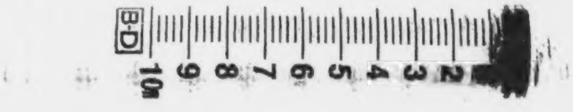
b. Is used to irrigate __________________ structures such as the ear

c. Is used for __________________ nasal and oral fluids from newborns during cesarean deliveries

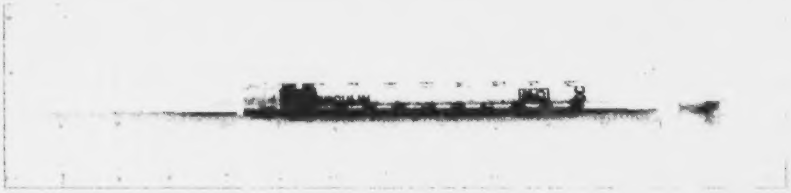
**OBJECTIVE 5** Identify the types of syringes used for injecting and aspirating. Write the correct answers in the blanks below the illustrations.



a. ______________________________________________



b. ______________________________________________



c. ______________________________________________

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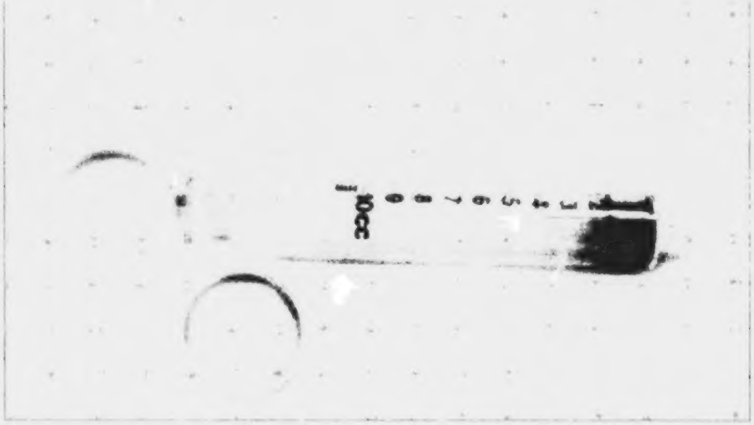


d. ________________________________________

e. ________________________________________

**OBJECTIVE 6** Distinguish between the types of syringe tips used for injecting and aspirating by placing an "L" for Luer-Lok tip and a "P" for plain tip on the blanks next to their characteristics.

_______ a. Has a tip that slips over the needle hub

_______ b. Is used with some catheter adapters and rubber connections for aspiration

_______ c. Has a tip that securely locks over the needle hub

_______ d. May not provide for a secure connection

_______ e. Is used whenever pressure needs to be exerted for injection or aspiration

**OBJECTIVE 7** Select true statements concerning the characteristics of hypodermic needles by writing an "X" on the blanks next to the true statements.

_____ a. Hypodermic needles may be used to withdraw medication from a vial, to inject medication into tissue, or to withdraw body fluids.

_____ b. Hypodermic needle diameters are indicated by a gauge number.

_____ c. Gauge numbers range from 2 to 14.

_____ d. Small needles (in diameter) have small gauge numbers.

_____ e. Large needles (in diameter) have large gauge numbers.

_____ f. The larger the needle, the smaller the gauge number; the smaller the needle, the larger the gauge number.

_____ g. 14–18 gauge needles may be used for aspiration of body fluids and transfusion of blood or blood components.

_____ h. Needles range in length from ¼″ to 2″.

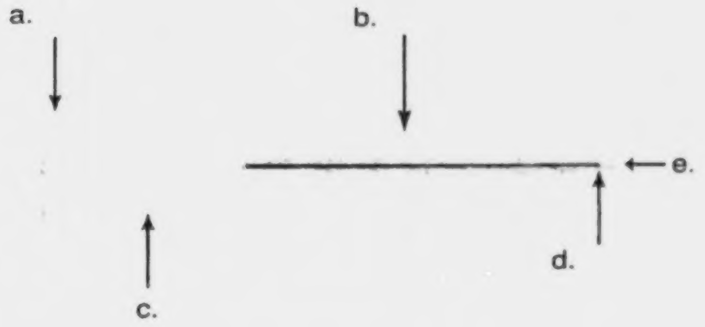
_____ i. Extra long needles are used for intradermal or subcutaneous injections such as for injecting a local anesthesia.

_____ j. Longer needles of medium gauge are used for intravenous or intramuscular injections.

_____ k. Small, short needles may be used to enter a body cavity.

_____ l. Spinal needles are long and have a stylet which fits through the cannula and slips into place.

**OBJECTIVE 8** Identify the parts of a hypodermic needle. Write the correct answers in the blanks below.



a. ______________________________ b. ______________________________

c. ______________________________ d. ______________________________

e. ______________________________

**OBJECTIVE 9** Complete statements concerning the care and handling of syringes and hypodermic needles. Write your answers on the blank lines provided in the statements below.

a. ___ _______________ technique must be used when handling syringes and needles. The needle, tip and hub, the inside of the barrel, and the plunger must be kept sterile.

b. Be careful not to touch the plunger except at the ________________. Any contamination of the plunger will contaminate the solution or medication as the plunger goes down the barrel.

c. If two or more syringes of the same type and size, but containing different solutions or medications, are being used, immediate ____________________ of the drugs is required to minimize the potential for error.

d. If the syringe is reusable, the plunger must be removed in order to clean the barrel using ____________________.

e. For sterilization, the syringes must be lying ________________ with the plunger removed.

f. Care must be taken to determine if the patient is at risk for ________________ sensitivity.

g. If a needle is broken, it must be accounted for in its ____________________.

**OBJECTIVE 10** Select true statements concerning the Occupational Safety and Health (OSHA) regulations concerning the care and handling of sharps by writing an "X" on the blanks next to the true statements.

_____ a. Only needles that are uncontaminated may be removed from a syringe.

_____ b. Contaminated needles and other contaminated sharps shall not be bent, recapped, or removed unless the employer can demonstrate that no alternative method is feasible or that such action is required by a specific surgical procedure.

_____ c. Bending, recapping, or needle removal is acceptable if accomplished by use of a mechanical device or two-handed technique.

_____ d. Shearing or breaking of contaminated needles is prohibited.

_____ e. Discard contaminated disposable sharps immediately or as soon as feasible into a color coded, biohazard trash bag.

***Permission to duplicate this test is granted.**

## Answers to Written Test

**Objective 1**

Answers may appear in any order.
a. Used for injection of medications or local anesthesia
b. Used for aspiration of body fluids
c. Used for irrigation of surgical wounds

**Objective 2**

a, c

**Objective 3**

a. Tip
b. Barrel
c. Calibrations
d. Flange
e. Plunger

**Objective 4**

**Bulb with a removable barrel**

a. rubber
b. irrigation
c. 120

**Bulb without a barrel**

a. one
b. small
c. suctioning

**Objective 5**

a. Insulin
b. Standard
c. Tuberculin
d. Control
e. Tubex

**Objective 6**

a. P
b. P
c. L
d. P
e. L

**Objective 7**

a, b, f, g, j, l

## Module 3-D: Syringes and Hypodermic Needles

| | |
|---|---|
| **OBJECTIVE 8** | a. Flange<br>b. Cannula<br>c. Hub<br>d. Lumen<br>e. Point |
| **OBJECTIVE 9** | a. Aseptic<br>b. end<br>c. labeling<br>d. pipe cleaner or appropriate brush<br>e. sideways<br>f. latex<br>g. entirety |
| **OBJECTIVE 10** | a, b, d |

## Answers to Assignment Sheet

**Assignment Sheet 1**

1. 2.8 cc
2. 74 units
3. .66 cc
4. 1.2 cc
5. .7 cc

## Module Review

Name __________________________________________

Date ______________________ Score ______________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 5

1. A ____________________ syringe has two finger rings and the plunger has a thumb ring to allow the surgeon to have a firm grip when injecting with one hand.
   - a. standard
   - b. insulin
   - c. control
   - d. bulb

Objective 10

2. The Occupational Safety and Health Administration (OSHA) regulations of bloodborne hazards is very specific concerning the care and handling of ________________.
   - a. uncontaminated needles
   - b. sharp objects
   - c. syringes
   - d. bulb syringes

Objective 2

3. Which of the following statements concerning the characteristics of a syringe is FALSE?
   - a. Syringes used for injection of medications or aspiration of fluids are used with various size needles.
   - b. Syringes are made of two types of materials: plastic and glass.
   - c. All syringes are calibrated in cubic centimeters.
   - d. Syringes for irrigation are used without a needle.

Objective 4

4. The ________________ syringe is made of plastic or rubber attached to a tapered or blunt end barrel.

   a. control

   b. insulin

   c. bulb

   d. standard

Objective 6

5. A luer-lok syringe has a tip that ______________________________.

   a. slips on easily for quick usage

   b. securely locks over the needle hub

   c. is used with some catheters and rubber connection for aspiration

   d. may not give a secure connection

Objective 5

6. A standard syringe is calibrated in ________________________.

   a. cubic centimeters

   b. units

   c. hundredth of a cubic centimeter

   d. none of the above

Objective 8

7. The part of a hypodermic needle indicated by the letter "X" in the illustration on the next page is the ____________________.

   a. cannula

   b. flange

   c. hub

   d. point

Objective 8

8. The part of a hypodermic needle indicated by the letter "Y" in the illustration on the next page is the ___________________.

   a. cannula

   b. flange

   c. hub

   d. point

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Objective 8

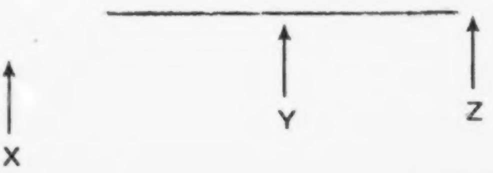
9. The part of a hypodermic needle indicated by the letter "Z" in the illustration below is the ____________________.

   a. point

   b. cannula

   c. lumen

   d. barrel



Objective 1

10. All of the following are uses of syringes in the operating room EXCEPT which of the following?

   a. tissue biopsies

   b. irrigation of wounds

   c. aspiration of body fluids

   d. injection of medication

Objective 9

11. When selecting a syringe, care must be taken to determine if the patient is at risk for ______________________ sensitivity.

   a. plastic

   b. latex

   c. both of the above

   d. none of the above

Objective 3

12. The part of a syringe indicated by the letter "W" in the illustration on the next page is the ____________________.

   a. tip

   b. plunger

   c. hub

   d. calibration

Objective 3

13. The part of a syringe indicated by the letter "X" in the illustration below is the ____________________.

    a. barrel

    b. calibration

    c. flange

    d. plunger

Objective 3

14. The part of a syringe indicated by the letter "Y" in the illustration below is the ____________________.

    a. calibration

    b. tip

    c. flange

    d. plunger

Objective 3

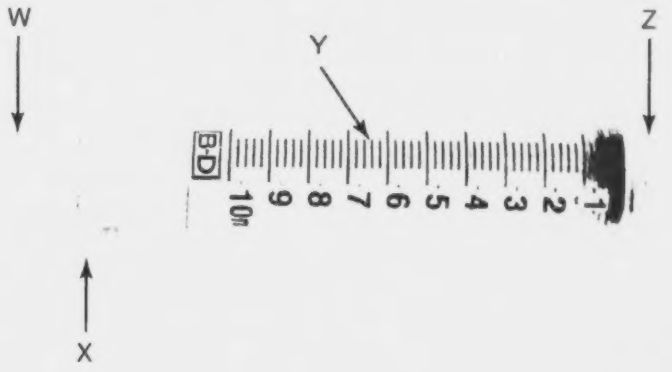
15. The part of a syringe indicated by the letter "Z" in the illustration below is the ____________________.

    a. tip

    b. plunger

    c. hub

    d. calibration



Objective 10

16. Shearing or breaking of contaminated needles is __________________________.

    a. an acceptable practice as long as a mechanical device is used

    b. prohibited

    c. an acceptable practice if required for a surgical procedure

    d. acceptable if stated as a proper means of disposal in the hospital policy and procedure manual

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Objective 4

17. A two-piece bulb syringe is available in various capacity sizes. The largest holds approximately ____________________.

    a. 120 cc

    b. 150 cc

    c. 50 cc

    d. 100 cc

Objective 7

18. Hypodermic needles may be used for all of the following EXCEPT ____________________.

    a. withdrawal of medication from a vial

    b. to inject medication into tissue

    c. to withdraw medication from an ampule

    d. to withdraw body fluids

Objective 6

19. A plain (slip) tip syringe has a tip that slips over the needle's ____________________.

    a. flange

    b. lumen

    c. cannula

    d. hub

Objective 5

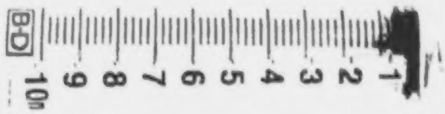
20. The type of syringe in the illustration below is a ____________________.

    a. control

    b. standard

    c. insulin

    d. tuberculin



Objective 4

21. A ____________________ syringe is used with one-handed control for irrigation during many types of surgical procedures.

    a. control

    b. standard

    c. tubex

    d. bulb

Objective 2

22. Syringes are available in sizes ranging from ____________________________.

    a. 2 cc to 50 cc

    b. 1 cc to 10 cc

    c. 5 cc to 100 cc

    d. 1 cc to 100 cc

Objective 4

23. One piece bulb syringes are used to irrigate ____________________________.

    a. small structures such as the ear

    b. large abdominal wounds

    c. traumatic wounds

    d. the nose of a newborn during a cesarean section delivery

Objective 5

24. A ____________________ syringe has a metal or plastic device used to accommodate a carpule of medication.

    a. standard

    b. control

    c. insulin

    d. tubex

Objective 7

25. Which of the following is a correct statement concerning the characteristics of hypodermic needles?

    a. Spinal needles are medium length needles that have a stylet with a sharp beveled tip, which fits through a cannula that locks into place to prevent leakage of spinal fluid.

    b. Filter needles are available for aspiration of fluids from a body cavity.

    c. Long needles of medium gauge are used for intravenous or intramuscular injections.

    d. 14–18 gauge needles may be used for intradermal or subcutaneous injections.

Objective 9

26. ____________________ technique must be used when handling syringes and needles.

a. Aseptic

b. Sterile

c. Septic

d. Unsterile

Objective 5

27. _______________ syringes are calibrated in units and have a 1 cc capacity.

a. Insulin

b. Tuberculin

c. Bulb

d. Standard

Objective 9

28. If two or more syringes of the same type and size re on the sterile field containing different solutions or medications, immediate labeling of the drug is ______________________________.

a. optional if there is a chance of mixing up the syringes

b. not necessary if the surgical technologist can remember which syringe contains which medication

c. required to minimize the potential for error

d. required if the size of the needle is change

Objective 10

29. Contaminated needles and other contaminated sharps may be bent, recapped, or removed if ____________________________.

a. the employer can demonstrate that no alternative method is feasible

b. such action is required by a specific surgical procedure

c. accomplished by the use of a mechanical device or one-handed technique

d. all of the above

Objective 5

30. A _________________ syringe is used when a very precise amount of a solution is administered.

a. tuberculin

b. insulin

c. standard

d. control

Objective 7

31. Which of the following statements is FALSE concerning hypodermic needles?

a. Hypodermic needles may be used to withdraw medication from a vial, to inject medication into tissue, or to withdraw body fluids.

b. Most needles used in the operating room are disposable and the hub is color coded by size.

c. The diameter of hypodermic needles is indicated by a gauge number which means the diameter of the needle and range from size 12 to 30.

d. The larger the diameter of the needle, the larger the gauge; the smaller the diameter of the needle, the smaller the gauge.

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. c
2. b
3. c
4. c
5. b
6. a
7. c
8. a
9. a
10. a
11. b
12. b
13. c
14. a
15. a
16. b
17. a
18. c
19. d
20. b
21. d
22. d
23. a
24. d
25. c
26. a
27. a
28. c
29. d
30. a
31. d

# Introduction to Surgical Technology

## SECTION D: Pharmacology

### Module 4-D: Pharmacologic Agents

## Module Contents

Page

**COMPONENTS**

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  1—Preparations of Drugs ........ 9
  2—Sources of Drugs ........ 11

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Answers to Written Test ........ 27

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module" and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.
- Discuss and demonstrate the job sheet. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of this activity and the rating scale that will be used to indicate job performance.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.

- Evaluate the job sheet. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

  **Sample A**

  4—**Skilled**—Can perform job with no additional training.
  3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
  2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
  1—**Unskilled**—Is familiar with process, but is unable to perform job.
  0—**No exposure**—No information or practice provided during training program.

  **Sample B**

  **Yes**—Can perform job with no additional training.
  **No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.

- Make copies of, give, and evaluate the Module Review.

- Compile the Written Test, assignment-sheet, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.

- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.

- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to introduce students to different classifications, forms, sources, and characteristics of common drugs used in surgery as well as the procedure for care and handling of drugs on the sterile field.

- Provide students with a variety of drug information references to be used with Assignment Sheet 2. Explain the process of looking up information in drug reference books.
- Invite a local pharmaceutical sales representative to speak to your class about new drugs used in surgery. Have the representative also show samples.
- Discuss drugs commonly used in your local hospitals or other trade names that have not been included in this module. You may want your students to write those drugs in on their information sheets.
- Discuss medication mixtures commonly used in your local hospitals. Make up a worksheet with examples of mixtures and dilutions.
- Obtain educational resource materials and pamphlets on alcohol and drug abuse from your local health departments or substance abuse treatment centers. Share this information with the class. Discuss the most commonly abused substances.
- Discuss controlled substances as they relate to the surgical technologist.
- Obtain copies of area hospital operating room policies and procedures manuals for preparing, receiving, and administering medications. Discuss with the students any policies that differ from the information provided in this module.
- Assign students an Internet research project on the history of pharmacology. Have them present reports as an oral presentation. Discuss students' findings with the class.
- Discuss and demonstrate the correct procedure for labeling medication on the sterile field, and have students practice this procedure.
- Have students wear sterile gloves and/or surgical attire when practicing the job sheet for safety and to better simulate the actual operating room setting.

**RESOURCES USED IN DEVELOPING THIS MODULE**

- Asperheim, Mary Kaye. *Pharmacology: An Introductory Text.* 9th ed. Philadelphia: W.B. Saunders Co., 2002.
- Caruthers, Bob L., and Paul Price, ed. *Surgical Technology for the Surgical Technologist—A Positive Care Approach.* Albany, NY: Delmar, 2001.
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- Durgan, Jan Sr., and Zachary Hanan. *Pharmacy Practice for Technicians.* 2nd ed. Albany, NY: Delmar, 1999.
- Fortunato, Nancymarie. *Berry and Kohn's Operating Room Technique.* 9th ed. St. Louis: Mosby, Inc., 2000.
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- *Introduction to Surgical Technology.* 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Kee, Joyce LeFever, and Evelyn R. Hayes. *Pharmacology: A Nursing Process Approach.* 2nd ed. Philadelphia: W.B. Saunders Co., 1997.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery.* 11th ed. St. Louis: Mosby, Inc., 1999.
- Reiss, Barry S., and Mary E. Evans. *Pharmacological Aspects of Nursing Care.* 6th ed. New York: Delmar, 2001.
- Sheridan, Eleanor, H. Robert Patterson, and Edward Gustafson. *Falconer's the Drug, the Nurse, and the Patient.* 7th ed. Philadelphia: W.B. Saunders Co., 1998.
- Snyder, Katherine, and Chris Keegan. *Pharmacology for the Surgical Technologist.* Philadelphia: W.B. Saunders Co., 1999.
- Turley, Susan. *Understanding Pharmacology for Health Professionals.* 2nd ed. New York: Simon & Schuster, 1999.

**SUGGESTED WEB SITES***

✔ **NOTE:** The following Web sites offer information concerning pharmacologic agents used in surgery.

- http://www.pdrel.com/

  This is the Web site of the *Physicians Desk Reference.* It gives updated information on a medication's chemical, brand, and generic names, drug dosages, actions, usages and drug contraindications.

- http://www.pharmweb.net/

  This Web site includes information on news about products, clinical trial information, patient education materials, company press releases, annual reports, and job opportunities.

- http://www.usp.org/

  The United States Pharmacopoeia Web site is the most highly recognized and technologically advanced pharmacopoeia. The USP provides standards for more than 3,800 medications, dietary supplements, and other health care products.

- http://www.phrma.org/

  This is the Web site of the Pharmaceutical Research Manufacturers of America. Using this Web site, students can search for information about medicine in development by disease, indication, or drug name.

- http://www.drugfacts.com/

  This Web site provides facts and comparisons of drugs, top headline drug news, FDA approvals, and drug updates.

- http://www.nih.gov/

  This is the Web site for the National Institute of Health. It provides research information on preventing, detecting, diagnosing, and treating disease and disability from the rarest genetic disorder to the common cold.

- http://www.nlm.nih.gov/

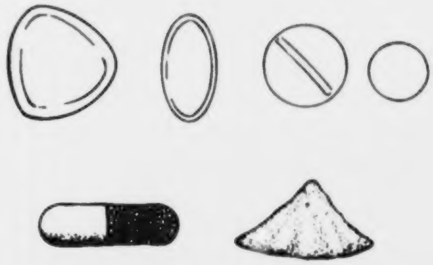
  This is the Web site for the National Library of Medicine. It provides current information on drugs, as well as information on the research of medication.

- http://www.nida.nih.gov/

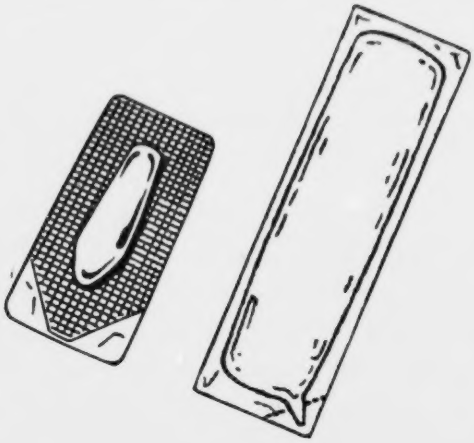
  This is the Web site for the National Institute on Drug Abuse (NIDA). This Web site provides results of research to significantly improve drug abuse and addiction prevention, treatment, and policy.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

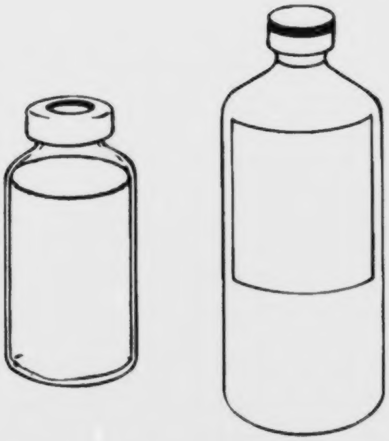
# Preparations of Drugs



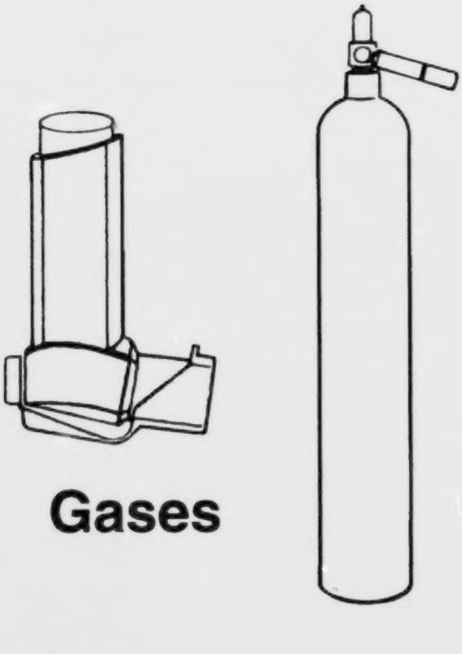
**Solids**



**Semi-Solids**



**Liquids**

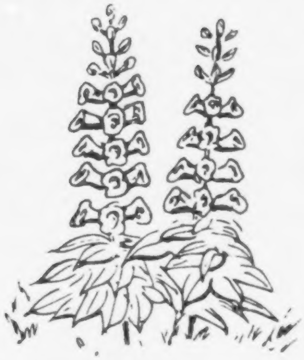


**Gases**

# Sources of Drugs

**Minerals**

Example: Iron is used to treat anemia.

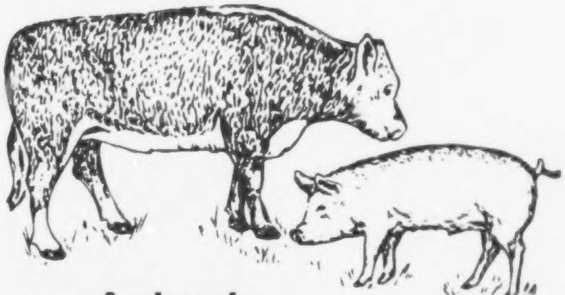


**Plants**

Example: The drug digitalis is obtained from the purple foxglove plant.

**Biotechnology**

Example: Human insulin and human growth hormones are synthetically mass produced using biotechnology.



**Animals**

Example: Insulin from the pancreas of a cow or pig may be used to treat diabetes.

**Synthetic**

Example: Penicillin is produced in the laboratory to treat bacterial infections.

# Introduction to Surgical Technology
# Section D: Pharmacology
# Module 4-D: Pharmacologic Agents

## Written Test

Name ______________________________

Date ____________________ Score ____________________

**OBJECTIVE 1** Define *pharmacology*, *pharmacodynamics*, *pharmacokinetics*.

a. Pharmacology— ______________________________

b. Pharmacodynamics— ______________________________

c. Pharmacokinetics— ______________________________

**OBJECTIVE 2** List the four general purposes of drugs.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 3** List the four types of drug preparations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 4**

List the five primary sources of drugs.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

**OBJECTIVE 5**

Distinguish among the types of names that a drug may have by placing an "X" next to the descriptions of the brand name (trade name).

_______ a. Symbol ® is used behind the name.

_______ b. Exact chemical formula of the drug

_______ c. Common or general name assigned to the drug when it is ready to be marketed

_______ d. Can be distinguished from other types of names that a drug may have by capitalized first letter

_______ e. Usually a long, very difficult name to pronounce

_______ f. Name by which a pharmaceutical company identifies its product; is copyrighted and used exclusively by that company

**OBJECTIVE 6**

Select the common sources of information concerning drugs by placing an "X" in the appropriate blanks.

_______ a. *Modern Drug Usage*

_______ b. *United States Pharmacopoeia and National Formulary (USP/NF)*

_______ c. *Webster's New Collegiate Dictionary*

_______ d. *Physician's Desk Reference (PDR)*

_______ e. *Taber's Cyclopedia Medical Dictionary*

_______ f. *American Hospital Formulary Service Drug Information (AHFS)*

**Objective 7**

Distinguish between the types of drug effects on the human body by placing an "X" next to the description of a systemic effect.

_______ a. The effect is limited to the area of the body where it is administered.

_______ b. The effect has the ability to be absorbed and distributed throughout the body to produce a physiological change.

**Objective 8**

Complete statements concerning the route of administration of drugs. Write your answers on the blank lines provided in the statements below.

a. Oral medication is administered through the mouth into the ____________________.

b. The ________________ route of administration involves applying the medication directly to the skin via a porous membrane for a systemic effect.

c. The inhalation route of administration of drugs involves inhaling a drug in the form of a ________________ or ________________ into the alveoli of the lung.

d. The subcutaneous route of administration involves injection of medication into the ____________________ layer of tissue directly below the ____________________ of the skin.

e. The ____________________ route involves placing the medication between the cheek and the gums until absorbed or dissolved.

f. The intravenous route of administration involves injection of liquid medication directly into the vein to produce a ____________________ effect.

g. In the ____________________ route, the drug is applied directly to the skin, mucous membrane of the eyes, ears, nose, or mouth, or on the surfaces of structures in an open wound.

h. Rectal administration of medication is via the ________________________.

i. The intra-articular route of administration involves injection of a liquid into a ____________________ in the body.

j. In the intrathecal route, medication is injected into the ____________________ space of the spinal cord.

k. The vaginal route of administration is used for the application of ________________ and ________________.

l. The ________________ route involves placing the medication under the tongue until the drug has been absorbed or dissolved.

m. In the __________________ route, the medication is injected directly into the muscle.

n. The intracardiac route involves injecting the medication directly into the ________________.

**OBJECTIVE 9** Match the classifications of common drugs used in surgery with their correct actions. Write the numbers on the blanks provided.

✔ **NOTE:** The classifications of drugs on this page match the actions listed on this page.

_______ a. Used to prevent or treat nausea and vomiting

_______ b. Produces loss of feeling and elimination of pain

_______ c. Influences the function of the urinary system to increase urine output

_______ d. Prevents the development, growth, or proliferation of malignant or cancerous cells

_______ e. Inhibits the parasympathetic response by manifesting the drying up of body secretions

_______ f. Imitates the action of the sympathetic nervous system by stimulating nerve fibers to release epinephrine

_______ g. Prevents the formation of blood clots by inhibiting one or several clotting factors

_______ h. Promotes and accelerates blood clotting

_______ i. Reduces the number or severity of seizures in patients with epilepsy

_______ j. Destroys bacteria and other pathogenic microorganisms

_______ k. Decreases the symptoms of inflammation of the musculoskeletal system

_______ l. Used to break down the fibrin in a blood clot and prevent the polymerization of fibrin in new clots

_______ m. Blocks the secretion of epinephrine from the sympathetic nervous system

_______ n. Reduces fever

_______ o. Blocks the effect of histamine release in an allergic reaction

_______ p. Acts on the heart and blood vessels

_______ q. Selectively suppresses pain without producing sedation

_______ r. Stimulates the central nervous system

1. Adrenergic
2. Adrenergic blocker
3. Analeptic
4. Analgesic
5. Anesthesia
6. Antibiotic/ anti-infective agent
7. Anticholinergic
8. Anticoagulant
9. Anticonvulsant
10. Antiemetic
11. Antihistamine
12. Anti-inflammatory
13. Antineoplastic
14. Antipyretic
15. Cardiovascular agent
16. Coagulant
17. Diuretic
18. Fibrinolytic/ Thrombolytic agent

✔ **NOTE:** The classifications of drugs on this page match the actions listed on this page.

_______ s. Specifically acts to relieve spasms and stiffness of the skeletal muscles

_______ t. Used to treat anxiety, anxiousness, or mental tension

_______ u. Relieves moderate to severe pain, produces sedation, and gives a feeling of euphoria

_______ v. Dilates blood vessels

_______ w. Stimulates uterine contraction and treats postpartum bleeding

_______ x. Exerts a soothing or tranquilizing effect but does not produce sleep

_______ y. Stimulates organ by chemical action to increase activity or to secrete another hormone

_______ z. Induces sleep and insensibility to pain

_______ aa. Reduces the amount of gastric acid present in the stomach

_______ bb. Enhances clot formation and reduces bleeding

_______ cc. Has an adrenergic action used to constrict blood vessels

19. Hemostatic
20. Histamine receptor blocker
21. Hormone
22. Hypnotic
23. Muscle relaxant
24. Narcotic
25. Oxytocic
26. Sedative
27. Tranquilizer
28. Vasodilator
29. Vasoconstrictor

**OBJECTIVE 10**

Select true statements concerning the characteristics of anticoagulants by placing an "X" in the blanks next to the true statements.

_____ a. Anticoagulants are used to prevent the clotting of blood.

_____ b. Anticoagulants are never used during cardiovascular procedures.

_____ c. Anticoagulants prevent clot formation around vessels when used as an irrigating solution in surgical wound.

_____ d. Anticoagulants cannot be given intravenously.

_____ e. The most common parenteral anticoagulant used is heparin sodium.

_____ f. Heparin comes in only one concentration.

_____ g. The principle postoperative complication of anticoagulant therapy is spontaneous bleeding.

_____ h. The antagonist for heparin is Narcan®.

**OBJECTIVE 11**

Complete statements concerning the characteristics of hemostatic agents by circling the correct answers.

a. Hemostatic agents are used to **(delay, promote)** blood coagulation when bleeding cannot be controlled by standard methods of hemostasis such as clamping, ligating, applying hemostatic clips, and electrosurgery.

b. Hemostatic agents used in surgery are administered systemically or **(orally, topically)** in the forms of powders, sponges, solutions, or films.

c. **(Vitamin K, Thrombin)** is administered systemically as a hemostatic agent.

d. **(Systemic, Topical)** hemostatic agents can be administered intravenously, intramuscularly, orally, or subcutaneously depending on the form of the medication.

e. Thrombin is applied topically and should **(always, never)** be injected.

f. **(Thrombin, Avitene®)** is a dry powder which is dissolved in a sterile saline solution and may be used in conjunction with other topical hemostatic agents to control surgical bleeding.

g. Bone wax is a topical hemostatic agent made of **(beeswax, cellophane)**.

h. Bone wax is primarily used in **(gynecology, neurosurgery)** and orthopedics to control bleeding by acting as a mechanical barrier.

i. **(Gelfilm®, Gelfoam®)** has a stiff cellophane appearance when dry and has a soft elastic consistency when moistened.

j. Gelfilm® absorbs completely by the tissues in **(4 to 6, 8 to 10)** weeks.

k. **(Gelfoam®, Thrombin)** is an absorbable gelatin sponge available in various sizes.

l. **(Avitene®, Gelfoam®)** is a microfibrillar collagen hemostatic agent which should be applied with dry smooth forceps.

m. **(Surgicel®, Oxycel®)** is available in two forms—cotton and gauze.

n. **(Thrombin, Helistat®)** must be kept dry, and should be applied with dry gloves and instruments.

o. Tannic acid is applied **(systemically, topically)** to the mucous membranes of the nose and throat to help capillary bleeding.

p. Tannic acid **(mechanically, chemically)** cauterizes bleeding surfaces.

q. Silver nitrate is used **(topically, subcutaneously)** as an astringent and an antimicrobial agent used commonly in the treatment of burns.

r. Silver nitrate should not be used around the eyes because of its **(cauterizing, corrosive)** effects.

**OBJECTIVE 12** Select true statements concerning the characteristics of antibiotics/anti-infectives commonly used in surgery by placing an "X" in the blanks next to the true statements.

_____ a. Antibiotics/anti-infectives are used to manufacture or increase the growth of pathogenic microorganisms.

_____ b. Antibiotics/anti-infectives may be used topically as an irrigating solution, applied as an ointment, or given intravenously before or during a surgical procedure for prophylaxis against postoperative wound infections.

_____ c. Aminoglycosides are not absorbed when applied topically during a surgical procedure.

_____ d. Aminoglycosides are used for long-term treatment of serious infections of the skin, bones, respiratory tract, alimentary tract, and central nervous system.

_____ e. Cephalosporins are bactericidal and are active against many gram-positive and some gram-negative microorganisms.

_____ f. Cephalosporins are used prophylactically in various surgical procedures to prevent postoperative wound infection and serious infections of the respiratory and genitourinary tract, skin, soft tissue, bone and joints.

_____ g. Macrolides are administered intravenously and act as a bacteriostatic agent used against several gram-negative bacteria such as Streptococcus erythreus.

_____ h. Penicillins are effective against a wide variety of gram-positive and gram-negative bacteria.

_____ i. Common penicillins include ampicillin, amoxicillin, carbenicillin, mezlocillin, penicillin V, and piperacillin.

_____ j. Tetracyclines have bacteriostatic action against bacteria.

_____ k. Bacitracin is used topically for infections caused by various bacteria and is available in powder or ointment form. It should never be injected.

**OBJECTIVE 13** Complete statements concerning narcotic analgesics by circling the correct answers.

a. Narcotic analgesics are primarily used to **(produce sleep, relieve pain)** preoperatively, intraoperatively, and postoperatively.

b. Narcotic analgesics are capable of causing dependence with **(regular, irregular)** use. These are classified as controlled substances by the federal government.

c. The Drug Enforcement Agency (DEA) sets standards for handling **(controlled substances, antibiotics)**.

d. Adverse effects to narcotics include nausea, vomiting, **(respiratory, cardiac)** depression, and reduced intestinal motility.

e. Narcotic antagonists such as **(Narcan®, Demerol®)** should be on hand to reverse the depressant effects of narcotics if needed.

f. Morphine sulfate is a very potent, **(nonaddictive, addictive)** narcotic that raises the pain threshold, produces sedation, and depresses the respirations.

g. Meperidine hydrochloride is the most common synthetic narcotic used for preoperative injections and postoperative pain. It is used as a substitute for morphine sulfate because it **(does, does not)** depress respirations as morphine does.

h. Fentanyl citrate **(Sublimaze®, Epifrin)** is used as an adjunct to general anesthesia to relieve pain and produce sedation.

i. Alfentanil is a(n) **(long, ultra-short)** acting narcotic agent. It has a slow onset which lasts only about 10–15 minutes.

j. Sufentanil (Sufenta®) is **(5–10, 1–3)** times more potent than fentanyl, but it is rapidly absorbed by the body to provide a rapid recovery.

k. Cocaine hydrochloride is used in surgery to shrink mucous membranes and to reduce bleeding in the nose. It is administered topically and **(must, must never)** be injected due to its **(low, high)** toxicity.

**OBJECTIVE 14** Match drugs used for ophthalmic surgery with their correct uses. Write the numbers on the blanks provided.

_______ a. Used locally or topically to produce the absence of all sensation

_______ b. Constrict the pupil to reduce intraocular pressure

_______ c. Proteins that act as a catalyst to speed up chemical reactions

_______ d. Used to irrigate the anterior chamber to keep the cornea and eye tissue moist and to soak and rinse intraocular lenses

_______ e. Paralytic agents used to dilate the pupil prior to ophthalmoscopy; administered by drop form

_______ f. Used to prevent or treat infections; may be administered topically, or by an injection, but usually are administered by topical drops or ointment

1. Anesthetic agents
2. Antibiotics
3. Enzymes
4. Irrigants
5. Miotics
6. Mydriatics/cycloplegics

**OBJECTIVE 15** Select true statements concerning the characteristics of diuretics by placing an "X" in the blanks next to the true statements.

_____ a. Diuretics are used to increase reabsorption of sodium and water by the kidneys.

_____ b. Diuretics draw fluids from the tissues and into the urinary system.

_____ c. In surgery, diuretics are commonly used to reduce intraocular or intracranial pressure.

_____ d. Adverse effects of using diuretics include hyperkalemia.

_____ e. A common osmotic diuretic used in surgery is Mannitol.

_____ f. Furosemide (Lasix®) increases intracranial pressure by quickly removing fluids that have accumulated because of a head trauma or an intracranial surgical procedure.

**Objective 16**

Select true statements concerning the characteristics of steroids by placing an "X" in the blanks next to the true statements.

_____ a. Steroids are commonly used in surgery to reduce tissue inflammation and postoperative swelling.

_____ b. Steroids are particularly useful in pediatric surgery.

_____ c. Steroids can only be administered intramuscularly.

_____ d. Common synthetic steroids include Aristocort®, Kenalog 40®, and Decadron®.

**Objective 17**

Complete statements concerning the characteristics of hormones. Write your answers on the blank lines provided in the statements below.

a. Oxytocic hormones are produced by the ____________________.

b. Hormones are used to stimulate the ____________________ to contract during labor.

c. Hormones are used in surgery to expel uterine contents (blood clots, placenta remnants) after a ________________ or a ____________________.

d. ____________________ and ____________________ are used in replacement therapy after surgical removal of ovaries.

e. Estrogen is available in a cream form which can be applied to vaginal packing placed after a ____________________.

f. Hormones produced by the pancreas regulate the metabolism of ____________________, a simple sugar used as an energy source.

g. Glucagon stimulates the ________________ to break down glycogen in glucose which then increases blood sugar levels.

h. ____________________ stimulates the liver to form glycogen from glucose which then lowers the blood sugar levels.

**Objective 18**

Complete statements concerning the characteristics of contrast media by circling the correct answers.

a. Contrast media are **(radioactive, radiopaque)** dyes used to outline various anatomical structures through x-ray.

b. Contrast media are commonly used in biliary surgery to determine the presence of stones which appear as **(dark, light)** spots against the white contrast media.

c. Contrast media are commonly used in cardiovascular and gastrointestinal surgery to identify **(enlargements, strictures)**.

d. Patients must be checked for allergies to **(iodine, iron)** prior to administration of contrast media.

e. Diatrizoate sodium, Hypaque®, Renografin®, and Conray® are used for radiography of the **(bones, biliary tract),** kidney, and other internal strictures.

f. Diatrizoate meglumine (Cystografin®) is used for radiography of the **(biliary, urinary)** tract.

g. Iohexol (Omnipaque®) is used for radiography of the **(female, male)** reproductive organs.

**OBJECTIVE 19**

Match common dyes used in surgery with their correct descriptions. Write the numbers on the blanks provided.

_______ a. Used to stain the cervical tissue

_______ b. Can be administered intravenously to color urine for evidence of bladder and kidney functions; may also be used for tracking fissures, fistulas, and determining the patency of fallopian tubes

_______ c. Used in surgery as a stain for marking the skin and to determine fallopian tube patency

_______ d. A purple dye used frequently in surgery to mark skin incision

_______ e. A colored staining agent used to identify areas of cervical dysplasia

1. Acetic acid
2. Gentian violet
3. Indigo carmine
4. Lugol's solution
5. Methylene blue

**OBJECTIVE 20**

Complete statements concerning the characteristics of intravenous solutions by circling the correct answers.

a. **(Some, Most)** patients scheduled for surgery will receive an intravenous solution when they come to the operating room.

b. Intravenous fluids are given **(intraoperatively, preoperatively)** to restore blood volume and replace fluids lost during the surgical procedure.

c. The **(intramuscular, intravenous)** route allows the surgical team (particularly the anesthesiologist) a convenient and efficient method for administering drugs and anesthesia agents as well as blood replacements and substitutes if needed.

d. **(Normal saline solution, Dextrose solution)** is the most common intravenous solution.

e. Dextrose in a water or saline solution is used for patients requiring an easily metabolized source of **(electrolytes, calories)**.

f. **(Langer's, Lactated Ringer's)** solution is a physiologic salt solution that may be used to replenish the patient's supply of electrolytes, to improve circulation, or to stimulate renal activity.

g. Plasmalyte® and Isolyte E® are electrolyte balanced solutions which are compatible with the pH of **(blood, water)**. They are used to treat massive fluid and electrolyte loss.

**OBJECTIVE 21**

Complete statements concerning blood replacements, blood components, and blood substitutes. Write your answers on the blank lines provided in the statements below.

a. Blood replacements and substitutes are commonly given intravenously for patients having a ______________________________.

b. ________________ include whole blood, plasma, packed blood cells, and platelets.

c. Source blood replacements can be donor blood, ________________ donation, ________________, or blood ________________.

d. Patients who are scheduled for a(n) ________________ surgical procedure may elect to donate their own blood for surgery.

e. The autologous donation protects the patient from potential ________________ transmission.

f. Another form of autologous donation used intraoperatively in surgery is called ________________. The process involves using a ________________ to collect, process, and return the patient's own blood.

g. Dextran® is an artificial plasma-volume expander which is especially valuable in treating ________________ resulting from hemorrhage.

h. Hetastarch (Hespan®) is also a common ________________ made of cornstarch.

**OBJECTIVE 22**

Match miscellaneous drugs used in surgery for emergency situations with their correct descriptions. Write the numbers on the blanks provided.

_______ a. A spasmolytic that is used to treat acute and chronic bronchial asthma, bronchospasms, pulmonary emphysema, Cheyne-Stokes respirations, and pulmonary edema

_______ b. An adrenergic used as a vasoconstrictor, as a cardiac stimulant, and to relax bronchioles; used to treat anaphylactic reactions, asthmatic attacks, and local hemorrhaging; also used to prolong the action of local anesthetic agents

_______ c. A sedating antihistamine used with epinephrine to treat anaphylaxis

_______ d. An adrenergic used to restore blood pressure in acute hypotensive states

_______ e. An antiarrhythmic used to treat premature ventricular contractions, ventricular arrhythmias, or ventricular tachycardia; also used as a local anesthetic agent

_______ f. A drug that acts directly on the myocardium; used to treat congestive heart failure, atrial tachycardia, and atrial fibrillation and flutter; slows the heart rate and strengthens contractions

_______ g. An anticholinergic drug used to treat bradycardia and bradyarrhythmia; also administered preoperatively to dry up oral secretions

_______ h. An alkalinizer used to treat metabolic acidosis, especially during a cardiac arrest

_______ i. A vasodilator drug used to dilate small vessels for surgical procedures such as AV shunts, fistulas, or femoral-popliteal bypasses

_______ j. A muscle relaxant given for the treatment of malignant hyperthermia

_______ k. A calcium blocker used to treat arrhythmias and angina

_______ l. An electrolyte replacement given to increase the force of the myocardial contractions

_______ m. An electrolyte which can cause a cardiac irritability if a deficiency is present

1. Aminophylline (Aminophyllin®)
2. Atropine sulfate
3. Calcium chloride
4. Dantrolene®
5. Digoxin (Lanoxin®)
6. Diphenhydramine hydrochloride (Benadryl®)
7. Epinephrine (Adrenalin®)
8. Lidocaine hydrochloride (Xylocaine®)
9. Norepinephrine injection (Levophed®)
10. Papaverine®
11. Potassium
12. Sodium bicarbonate
13. Varapamil

**OBJECTIVE 23**

Select true statements concerning the care and handling of medications by placing an "X" in the blanks next to the true statements.

_____ a. The surgical technologist often has to administer medications to the surgical patient.

_____ b. Medications may be accepted from vials that are cracked or chipped.

_____ c. Medications should never be accepted that appear discolored or suspicious.

_____ d. It is not necessary for the surgical technologist to read the medication label.

_____ e. Never use outdated medication. The composition and effect of the drug may be altered.

_____ f. It is the surgical technologist's responsibility to be aware of only local regulations concerning drugs and their administration.

_____ g. A surgical technologist can distribute medications to another surgical technologist.

_____ h. A verbal order from the physician for the distribution of a medication can only be taken by the nurse.

_____ i. Do not accept a medication from a vial or bottle you have not identified.

_____ j. Label only the medications on the sterile back table that are in containers. Syringes do not need to be labeled.

_____ k. If the medications are not clearly identified, they must be discarded and new medications obtained.

_____ l. Keep track of how much irrigation solution is used within the wound so that blood loss can be determined.

_____ m. It is not necessary to keep track of the amount of medication being used on the sterile field.

_____ n. It is the responsibility of both the circulating nurse and the surgical technologist to make certain that the correct drug, correct amount, and the correct strength are administered.

**OBJECTIVE 24**

Complete statements concerning the procedure for the surgical technologist to accept medication from the circulator. Place the letter for the correct answer in the blanks provided below.

_____ a. Which member of the surgical team is responsible for maintaining aseptic technique when delivering and receiving medication on the sterile field?

1. Circulator
2. Surgical technologist
3. Anesthesiologist
4. Circulator AND Surgical technologist

_____ b. Which member of the surgical team is responsible for labeling the medication once it has been distributed to the sterile field?

1. Circulator
2. Surgical technologist
3. Surgeon
4. Anesthesiologist

_____ c. Which member of the surgical team is responsible for obtaining the medication and checking the integrity of the container for cracks or discolored contents?

1. Circulator
2. Surgical technologist
3. Anesthesiologist
4. Circulator AND Surgical technologist

_____ d. Which member of the surgical team reads the label aloud prior to delivering the medication to the sterile field?

1. Circulator
2. Surgical technologist
3. Surgeon
4. None of the above

_____ e. Once the medication is on the sterile field, which team member is responsible to pass the correct medication in the strength specified by the surgeon?

1. Circulator
2. Surgical technologist
3. Anesthesiologist
4. Circulator AND Surgical technologist

_____ f. Which member of the surgical team is responsible for informing the surgeon of all medication and mixtures as the drug is passed intraoperatively?

1. Circulator
2. Surgical technologist
3. Anesthesiologist
4. Circulator AND Surgical technologist

***Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1**

a. Pharmacology—The study of drugs and their origin, nature, properties, and effect upon living organisms

b. Pharmacodynamics—The study of drugs and their actions on living organisms

c. Pharmacokinetics—The study of the metabolism and actions of drugs with emphasis on absorption, duration, distribution in the body, and method of excretion

**OBJECTIVE 2**

Answers may appear in any order.

a. Diagnosis
b. Treatment of symptoms
c. Treatment of disease or dysfunctions
d. Prevention of disease

**OBJECTIVE 3**

Answers may appear in any order.

a. Solid form
b. Semi-solids
c. Liquids
d. Gases

**OBJECTIVE 4**

Answers may appear in any order.

a. Plants
b. Minerals
c. Animals
d. Synthetic
e. Biotechnology

**OBJECTIVE 5** a, d, f

**OBJECTIVE 6** b, d, f

**OBJECTIVE 7** b

**Objective 8**

a. gastrointestinal tract
b. transdermal
c. gas, liquid
d. fatty, dermis
e. buccal
f. systemic
g. topical
h. rectum
i. joint
j. subarachnoid
k. creams, suppositories
l. sublingual
m. intramuscular
n. heart

**Objective 9**

a. 10
b. 5
c. 17
d. 13
e. 7
f. 1
g. 8
h. 16
i. 9
j. 6
k. 12
l. 18
m. 2
n. 14
o. 11
p. 15
q. 4
r. 3
s. 23
t. 27
u. 2
v. 29
w. 25
x. 26
y. 21
z. 22
aa. 20
bb. 19
cc. 28

**Objective 10**

a, c, e, g

**Objective 11**

a. promote
b. topically
c. Vitamin K
d. Systemic
e. never
f. Thrombin
g. beeswax
h. neurosurgery
i. Gelfilm®
j. 4 to 6
k. Gelfoam®
l. Avitene®
m. Oxycel®
n. Helistat®
o. topically
p. chemically
q. topically
r. corrosive

**Objective 12**

b, e, f, h, i, j, k

**OBJECTIVE 13**

a. relieve pain
b. regular
c. controlled substances
d. respiratory
e. Narcan®
f. addictive
g. does not
h. Sublimaze®
i. ultra-short
j. 5–10
k. must never, high

**OBJECTIVE 14**

a. 1
b. 5
c. 3
d. 4
e. 6
f. 2

**OBJECTIVE 15** b, c, d, e

**OBJECTIVE 16** a, d

**OBJECTIVE 17**

a. pituitary gland
b. uterus
c. cesarean section, therapeutic abortion
d. Estrogen, progesterone
e. vaginal hysterectomy
f. glucose
g. liver
h. Insulin

**OBJECTIVE 18**

a. radiopaque
b. dark
c. strictures
d. iodine
e. biliary tract
f. urinary
g. female

**OBJECTIVE 19**

a. 4
b. 3
c. 5
d. 2
e. 1

## Module 4-D: Pharmacologic Agents

**Objective 20**

a. Most
b. intraoperatively
c. intravenous
d. Normal saline solution
e. calories
f. Lactated Ringer's
g. blood

**Objective 21**

a. significant blood loss
b. Blood components
c. autologous, autotransfusion, substitutions
d. elective
e. bloodborne disease
f. autotransfusion, cell saver
g. hypovolemic shock
h. volume expander

**Objective 22**

a. 1
b. 7
c. 6
d. 9
e. 8
f. 5
g. 2
h. 12
i. 10
j. 4
k. 13
l. 3
m. 11

**Objective 23**

c, e, h, i, k, l, n

**Objective 24**

a. 4
b. 2
c. 1
d. 1
e. 2
f. 2

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 4-D: Pharmacologic Agents

### Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 21

1. Which of the following medications is an artificial plasma-volume expander?

   a. Mannitol

   b. Dextran®

   c. Ringer's solution

   d. Plasmalyte®

Objective 1

2. The study of drugs and their origin, nature, properties, and the effect upon living organisms is called ____________________.

   a. anatomy

   b. pharmacokinetics

   c. pharmacodynamics

   d. pharmacology

Objective 22

3. What drug is utilized in an anaphylactic reaction?

   a. Atropine sulfate

   b. Aminophylline

   c. Azo-Gantrisin®

   d. Adrenalin®

Objective 10

4. Which of the following is a drug that prevents blood clot formation?

   a. antibiotic

   b. coagulant

   c. oxytocic

   d. anticoagulant

Objective 22

5. An anticholinergic drug given preoperatively to inhibit mucous secretions is ______________________.

   a. Demerol®

   b. Talwin®

   c. Atropine®

   d. Narcan®

Objective 17

6. Hormones produced by the ______________________ are used to stimulate the uterus to contract during labor.

   a. adrenal gland

   b. pituitary gland

   c. ovaries

   d. pancreas

Objective 2

7. Which of the following is NOT a purpose for the use of a drug?

   a. treatment of symptoms

   b. treatment of diseases or dysfunctions

   c. experimental research

   d. diagnosis

Objective 6

8. What is the most widely used drug resource that contains information about drug dosages, indications, route of administration, adverse reactions, overdose, drug actions, and contraindications?

   a. AHFS

   b. USP/NF

   c. DEA

   d. PDR

Objective 7

9. The drug effect that has the ability to be absorbed and distributed throughout the body to produce a physiological change is the ______________________ effect.

   a. local

   b. systemic

   c. spinal

   d. regional

Objective 11

10. What type of pick-ups should be used when using the hemostatic agent Avitene®?

a. long

b. dry

c. short

d. wet

Objective 8

11. What route of administration involves the injection of medication into the fatty layer of tissue directly below the dermis of the skin?

a. intramuscular

b. subcutaneous

c. intravenous

d. intrathecal

Objective 11

12. ________________________ is a topical hemostatic agent that is applied directly to the bleeding surfaces of bone.

a. Gelfoam®

b. Thrombin

c. Surgicel®

d. Bone wax

Objective 7

13. The local effect of drugs is limited to ____________________________.

a. the area of the body where it is administered

b. by the amount of medicine administered

c. the strength of the medicine administered

d. the route of administration

Objective 24

14. Whose responsibility is it to remember the amount of medication used on the sterile field?

a. surgical technologist

b. circulator

c. surgeon

d. anesthesiologist

Objective 5

15. The ________________________ name is the exact chemical formula of a drug which is usually very long and difficult to pronounce.

    a. generic

    b. chemical

    c. trade

    d. brand

Objective 4

16. ______________________ is the newest source of drugs being used to synthetically mass produce previously rare and expensive drugs.

    a. Biotechnology

    b. Chemical

    c. Semi-synthetic

    d. Synthetic

Objective 13

17. When are narcotic analgesics used to relieve pain?

    a. preoperatively

    b. intraoperatively

    c. postoperatively

    d. all of the above

Objective 3

18. What form of medication is introduced into the respiratory tract to provide a systemic effect?

    a. gas

    b. liquid

    c. semi-solid

    d. solid

Objective 19

19. What dye is used in surgery as a stain for marking skin and to determine the patency of fallopian tubes?
    - a. indigo carmine
    - b. methylene blue
    - c. Lugol's solution
    - d. gentian violet

Objective 9

20. Which of the following is the correct classification for a drug that destroys bacteria and other pathogenic microorganisms?
    - a. antihistamine
    - b. anticoagulant
    - c. antipyretic
    - d. antibiotic/anti-infective

Objective 23

21. Which of the following statements concerning the care and handling of medications is FALSE?
    - a. It is the surgical technologist's responsibility to be aware of local, state, and federal regulations concerning drugs and their administration.
    - b. Only a registered nurse or physician can legally distribute medications to a surgical technologist.
    - c. The surgical technologist is responsible for receiving, preparing, mixing, and labeling all drugs on the sterile back table after properly cross-referencing with the circulator.
    - d. The surgical technologist can administer medications to patient if approved by the surgeon.

Objective 4

22. Drugs in use today come from which of the following sources?
    - a. plants
    - b. minerals
    - c. animals
    - d. all of the above

Objective 8

23. The ________________ route of administration is through the mouth into the gastrointestinal tract.

a. buccal

b. sublingual

c. topical

d. oral

Objective 9

24. A drug used to dilate blood vessels in surgical procedures such as cardiovascular bypasses is a(n) ________________________________.

a. cardiovascular agent

b. vasodilator

c. vasoconstrictor

d. anticoagulant

Objective 11

25. Hemostatic agents used in surgery are administered systemically or ________________________ in the form of powders, sponges, solutions, or films.

a. intravenously

b. topically

c. intramuscularly

d. subcutaneously

Objective 13

26. Which of the following drugs should be on hand to reverse the depressant effects of narcotics if needed?

a. Narcan®

b. Sublimaze®

c. protamine sulfate

d. meperidine hydrochloride

Objective 3

27. What form of medication are creams, ointments, gels, dermal patches, and suppositories?

a. solid

b. semi-solid

c. liquid

d. oral

Objective 11

28. Which of the following is a hemostatic agent that is available in a powder or an absorbable gelatin sponge form which may be cut to the desired size or shape depending on the application?

    a. Avitene®

    b. Surgicel®

    c. Gelfoam®

    d. thrombin

Objective 10

29. Which of the following statements concerning the characteristics of anticoagulants is TRUE?

    a. Anticoagulants are used to promote the clotting of blood.

    b. Anticoagulants are used only in orthopedic and neurosurgical procedures.

    c. The most common anticoagulant used in surgery is protamine sulfate.

    d. The principle postoperative complication of anticoagulant therapy is spontaneous bleeding.

Objective 12

30. Which of the following statements concerning aminoglycoside antibiotics is TRUE?

    a. Aminoglycoside antibiotics are not effective against aerobic gram-negative and some gram-positive bacteria.

    b. Aminoglycoside antibiotics are not completely absorbed if applied topically.

    c. Aminoglycoside antibiotics are used for short-term treatments of serious infections of the skin, bones, respiratory tract, alimentary tract, and the central nervous system.

    d. Common aminoglycosides used in surgery include Kefzol®, Ancef®, and Duricef®.

Objective 13

31. What is the most common synthetic narcotic used for preoperative injections and postoperative pain?

    a. morphine sulfate

    b. Demerol®

    c. Sufenta®

    d. cocaine hydrochloride

Objective 9

32. A drug that produces the loss of feeling and elimination of pain is classified as a(n) ____________________.

   a. analgesic
   b. anti-inflammatory
   c. anesthesia agent
   d. sedative

Objective 14

33. ____________________ are paralytic agents used to dilate the pupil prior to ophthalmoscopy.

   a. Mydriatics
   b. Cycloplegics
   c. Miotics
   d. Both A and B

Objective 11

34. ____________________ are used to promote blood clotting when bleeding cannot be controlled by standard methods of hemostasis such as clamping, ligating, applying hemostatic clips, and electrosurgery.

   a. Anticoagulants
   b. Antibiotics
   c. Antipyretics
   d. Hemostatic agents

Objective 15

35. Which of the following statements is FALSE concerning the characteristics of a diuretic?

   a. Diuretics are used to prevent reabsorption of sodium and water by the kidneys.
   b. In surgery, diuretics are commonly used to reduce intraocular or intracranial pressure.
   c. Mannitol (Osmitrol®) is the most common osmotic diuretic used to provide a rapid reduction in intraocular pressure in patients with glaucoma.
   d. Adverse effects of using diuretics include hyperkalemia.

Objective 12

36. Which of the following statements is FALSE concerning the characteristics of cephalosporin antibiotics?

    a. Cephalosporin antibiotics are bactericidal and active against many gram-positive and some gram-negative microorganisms.

    b. The route of administration for cephalosporin antibiotics is intravenous only.

    c. Cephalosporin antibiotics are used prophylactically in various surgical procedures to prevent postoperative wound infection.

    d. Cephalosporin antibiotics are used for serious infections of the respiratory and genitourinary tract, skin, soft tissue, bone and joints.

Objective 20

37. The ____________________ route allows the surgical team, particularly the anesthesiologist, a convenient and efficient method for administering drugs and anesthesia agents.

    a. intramuscular

    b. intravenous

    c. subcutaneous

    d. intrathecal

Objective 11

38. Which of the following is a specially treated form of surgical gauze that has a hemostatic effect when buried in tissue?

    a. Surgicel®

    b. Gelfoam®

    c. Avitene®

    d. Gelfilm®

Objective 16

39. Which of the following is a TRUE statement concerning the characteristics of steroids?

    a. They are commonly used in surgery to reduce tissue inflammation and postoperative swelling.

    b. Steroids are particularly useful in cardiovascular surgical procedures.

    c. Steroids can only be administered intramuscularly.

    d. Common synthetic steroids include Pitocin® and Oxytocin®.

Objective 18

40. When a contrast media is used in biliary surgery, stones present in the ducts appear ________________.

a. dark
b. light
c. usually gray
d. do not appear if bubbles are present in the media

Objective 12

41. Which of the following statements concerning antibiotics/anti-infectives is FALSE?

a. Antibiotics/anti-infectives are used to destroy or inhibit the growth of pathogenic microorganisms.
b. Antibiotics/anti-infectives may be used topically as an irrigating solution.
c. Antibiotics/anti-infectives are used as a prophylaxis against postoperative wound infection.
d. Antibiotics/anti-infectives are categorized in classes either as a penicillin or tetracycline.

Objective 22

42. Which of the following is the drug of choice to treat metabolic acidosis occurring during a cardiac arrest?

a. potassium chloride
b. calcium carbonate
c. sodium bicarbonate
d. calcium gluconate

Objective 18

43. Contrast media are ________________ dyes used to outline various anatomical structures.

a. radiolucent
b. radioactive
c. radiopaque
d. radiosensitive

Objective 3

44. The solid form of medicine is absorbed through the ________________.

a. respiratory tract
b. circulatory system
c. integumentary system
d. alimentary tract

Objective 18

45. Patients must be checked for allergies to __________ prior to the administration of contrast media.

   a. iodine

   b. iron

   c. calcium

   d. potassium

Objective 17

46. Which of the following is an oxytocic drug used in surgery to expel uterine contents (blood clots, placenta remnants) after a cesarean section or a therapeutic abortion?

   a. Pitocin®

   b. insulin

   c. estrogen

   d. progesterone

Objective 24

47. When handing a syringe of medication to the surgeon for a local anesthetic, the surgical technologist should __________.

   a. ask the circulating nurse what solution he or she has

   b. ask the circulator to show the vial to the surgeon

   c. show the surgeon the vial that it came from

   d. state the kind and percentage of the solution

Objective 19

48. Which of the following is a strong iodine solution used to stain the cervix to test for cervical cancer?

   a. Lugol's solution

   b. acetic acid

   c. gentian violet

   d. indigo carmine

Objective 20

49. Intravenous fluids are given intraoperatively to __________ and replace fluids lost during the surgical procedure.

   a. replace lost calcium

   b. replace lost potassium

   c. restore blood volume

   d. none of the above

Objective 20

50. What is the most common intravenous solution used in surgery?

a. Dextrose in 5% water (D5W)

b. Dextrose in 5% Normal Saline (D5NS)

c. Normal Saline (NaCl)

d. Lactated Ringer's

Objective 21

51. Which of the following statements concerning blood replacements, blood components, and blood substitutes is FALSE?

a. Blood replacements and substitutes are commonly given intramuscularly to patients having a significant blood loss.

b. Blood components include whole blood, plasma, packed blood cells, and platelets.

c. Source blood replacements can be donor blood, autologous donation, autotransfusion, or blood substitutions.

d. The autologous donation protects the patient from potential bloodborne disease transmission.

Objective 14

52. Which of the following is a drug that constricts the pupil to reduce intraocular pressure?

a. enzyme

b. mydriatic

c. cycloplegic

d. miotic

Objective 21

53. Which of the following statements concerning blood substitutes is TRUE?

a. Normal serum albumin and plasma protein fraction acts to supply colloid to blood and expand plasma volume.

b. Dextran® is an artificial plasma-volume expander which is especially valuable in treating hypovolemic shock resulting from hemorrhage.

c. Hetastarch (Hespan®) is also a common volume expander made of cornstarch.

d. All of the above statements are true.

Objective 20

54. Plasmalyte® and Isolyte E® are electrolyte balanced solutions which are compatible with the pH of ____________________.

    a. blood

    b. water

    c. potassium

    d. sodium

Objective 22

55. An electrolyte which can cause a cardiac irritability if a deficiency is present is ____________________.

    a. calcium

    b. vitamin C

    c. sodium

    d. potassium

Objective 10

56. Which of the following medications is an anticoagulant given for its antagonistic effect on heparin?

    a. Dicumarol®

    b. Coumadin®

    c. protamine sulfate

    d. diazide

Objective 22

57. Which of the following drugs is used as a local anesthetic and as a myocardial depressant?

    a. Papaverine®

    b. bactitracin

    c. cocaine

    d. lidocaine

Objective 8

58. In the ____________________ route of administration, medication is applied directly to the skin, mucous membranes of the eyes, ears, nose, or mouth, or on the surface of structures in an open surgical wound.

    a. intramuscular

    b. transdermal

    c. topical

    d. intrathecal

Objective 22

59. Which of the following is a vasodilator drug used to dilate small vessels for surgical procedures such as A-V shunts, fistulas, or femoral-popliteal bypass?

a. pontocaine
b. protamine sulfate
c. Papaverine®
d. penicillin

Objective 23

60. Which of the following statements is TRUE concerning the care and handling of medication?

a. Medication can be accepted from vials that are cracked or chipped if the circulator is careful when opening the vial.
b. After accepting medication on the sterile field, it is an acceptable practice to wait until a convenient time to label the medication syringes and containers.
c. Inadequate or improper labeling on the sterile field may be considered negligent.
d. It is not necessary to keep track of the amount of medication being used on the sterile field.

Objective 5

61. What is the copyrighted name by which a pharmaceutical company identifies its product?

a. generic name
b. chemical name
c. brand name
d. manufacturer's name

Objective 24

62. Who is responsible for reading the label aloud prior to delivering the medication to the sterile field?

a. surgeon
b. surgical technologist
c. circulator
d. anesthesiologist

Objective 11

63. Which of the following is a dry powder which is dissolved in a saline solution to promote clotting on bleeding surfaces of delicate tissue and may be used in conjunction with other topical hemostatic agents?

a. thrombin

b. Gelfoam®

c. Avitene®

d. Surgicel®

Objective 9

64. Which of the following prevents the formation of blood clots by inhibiting one or several clotting factors?

a. anticoagulant

b. anticholinergic

c. hemostatic agent

d. coagulant

Objective 15

65. Hypokalemia is an abnormally low concentration of ________________ in the blood.

a. phosphate

b. calcium

c. magnesium

d. potassium

Objective 1

66. The study of the metabolism and actions of drugs with emphasis on absorption, duration, distribution in the body, and method of excretion is called ________________.

a. anatomy

b. pharmacokinetics

c. pharmacodynamics

d. pharmacology

Objective 14

67. Xylocaine® is an example of a(n) ________________ used for ophthalmic surgery.

a. anesthetic agent

b. antibiotic

c. irrigant

d. enzyme

Objective 16

68. Prednisone is a common ______________________.

    a. diuretic

    b. synthetic steroid

    c. hormone

    d. contrast media

Objective 17

69. _________________ stimulates the liver to break down ________________ in _________________ which then increases blood sugar levels.

    a. Glycogen, glucose, glucagon

    b. Glucose, glycogen, glucagon

    c. Glucagon, glucose, glycogen

    d. Glucagon, glycogen, glucose

Objective 19

70. Which of the following dyes can be administered intravenously to color urine for evidence of bladder and kidney functions?

    a. methylene blue

    b. gentian violet

    c. indigo carmine

    d. acetic acid

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. b
2. d
3. d
4. d
5. c
6. b
7. c
8. d
9. b
10. b
11. b
12. d
13. a
14. a
15. b
16. a
17. d
18. a
19. b
20. d
21. d
22. d
23. d
24. b
25. b
26. a
27. b
28. c
29. d
30. c
31. b
32. c
33. d
34. d
35. d
36. b
37. b
38. a
39. a
40. a
41. d
42. c
43. c
44. d
45. a
46. a
47. d
48. a
49. c
50. c
51. a
52. d
53. d
54. a
55. d
56. c
57. d
58. c
59. c
60. c
61. c
62. c
63. a
64. a
65. d
66. b
67. a
68. b
69. d
70. c

# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

### Module 5-D: Anesthesia

## Module Contents

**COMPONENTS**

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## Suggested Activities

**Instructional Plan**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**Preparation**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**Delivery and Application**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.

**Evaluation**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.

- Compile the Written Test and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to introduce students to anesthesia used in the operating room and to develop an understanding of the types of anesthetics and their applications.

- Demonstrate or arrange for a demonstration of anesthesia equipment. Demonstrations by outside resource people can be very important in assisting students learn practical applications of technology.
- Discuss the role of the surgical technologist during the induction of anesthesia, and in the case of emergency complications such as cardiac arrest, shock, vomiting, or malignant hyperthermia.
- Discuss the need to refrain from talking while a patient is being induced.
- Discuss the four stages of general anesthesia—conscious, excitement, surgical anesthesia, and medullary paralysis stage.
- Invite a representative from a local medical facility's anesthesiology department to talk to the class about new developments in their area and how their field interacts with surgical technology.

**RESOURCES USED IN DEVELOPING THIS MODULE**

- Asperheim, Mary Kaye. *Pharmacology: An Introductory Text.* 9th ed. Philadelphia: W.B. Saunders Co., 2002.
- Caruthers, Bob L., and Paul Price, ed. *Surgical Technology for the Surgical Technologist—A Positive Care Approach.* Albany, NY: Delmar, 2001.
- Clayton, Bruce D. *Basic Pharmacology for Nurses.* 12th ed. St. Louis: Mosby, Inc., 2001.
- *Core Curriculum for Surgical Technology.* 5th ed. Centennial, CO: Association of Surgical Technologists, 2002.
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- Fuller, Joanna R. *Surgical Technology—Principles and Practice.* 3rd ed. Philadelphia: W. B. Saunders Co., 1994.
- *Introduction to Surgical Technology.* 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Meeker, Margaret H., and Jane C. Rothrock. *Alexander's Care of the Patient in Surgery.* 11th ed. St. Louis: Mosby, Inc., 1999.
- Sheridan, Eleanor, H. Robert Patterson, and Edward Gustafson. *Falconer's the Drug, the Nurse, and the Patient.* 7th ed. Philadelphia: W.B. Saunders Co., 1998.

- Snyder, Katherine, and Chris Keegan. *Pharmacology for the Surgical Technologist.* Philadelphia: W.B. Saunders Co., 1999.

**SUGGESTED WEB SITES***

✔ **NOTE:** The following Web sites offer information concerning anesthesia used in the operating room environment.

- http://www.anesthesia-analgesia.org/

  This Web site is the official journal of the International Anesthesia Research Society. You can search or browse article archives related to anesthesia research.

- http://www.asahq.org

  The American Society of Anesthesiologists' (ASA) Web site contains educational and research articles related to anesthesiology, as well as links to related organizations, job placement information, and continuing education information.

- http://aana.com

  The American Association of Nurse Anesthetists is the professional association representing CRNAs nationwide. Their Web site includes membership, conference, and patient information, position statements and accredited programs.

- http://www.ispub.com/journals/ija.htm

  The Internet Journal of Anesthesiology is a peer-reviewed, free of charge, electronic anesthesiology journal that publishes original articles, reviews, case reports, and multimedia content.

- http://www.aspan.org

  This is the Web site of the Association of Perianesthesia Nurses. It contains information on education, clinical practice, research, information for patients, membership, as well as many other topics related to anesthesia.

- http://www.anesthesiology.org/

  The Journal of the American Society of Anesthesiologists' Web site contains abstracts in Adobe PDF format and text.

- http://www.gasnet.med.yale.edu

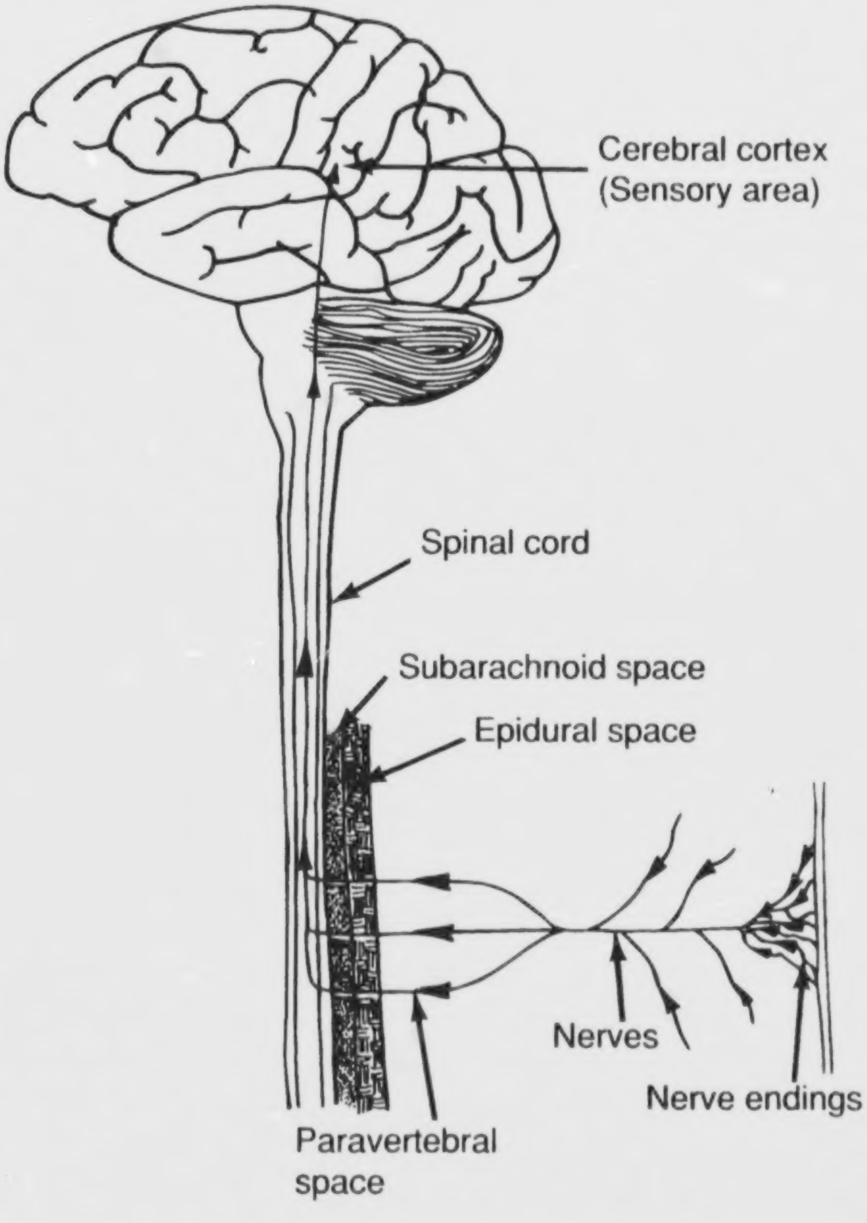
  This Web site contains information about anesthesiology, including a multimedia textbook, a video library, an online journal of anesthesiology and discussion groups.

- http://www.mhaus.org

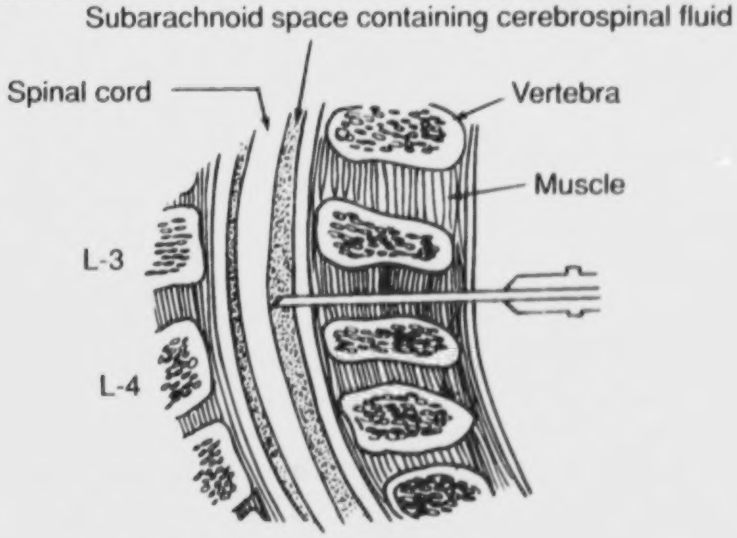
  The Malignant Hyperthermia Association of the United States (MHAUS) Web site contains ordering information for a wall chart describing accepted protocol for emergency therapy.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

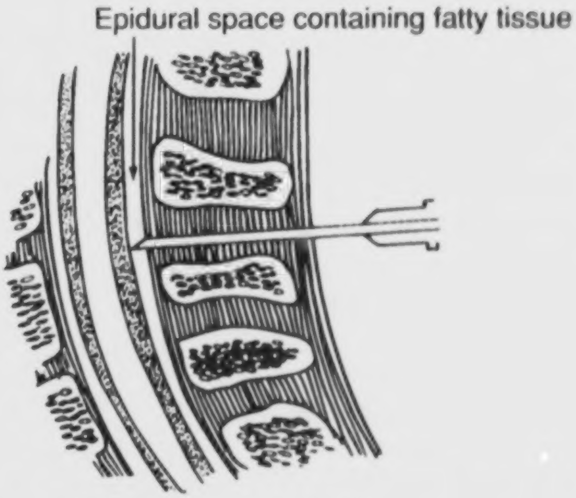
# Pathway of Pain


Cerebral cortex
(Sensory area)
Spinal cord
Subarachnoid space
Epidural space
Nerves
Nerve endings
Paravertebral
space

# Spinal and Epidural Anesthesia


Subarachnoid space containing cerebrospinal fluid
Spinal cord
Vertebra
Muscle
L-3
L-4

Spinal block
Injection into subarachnoid space


Epidural space containing fatty tissue

Epidural block
Injection into epidural space

## Written Test

Name ____________________________________________

Date ______________________ Score __________________

**OBJECTIVE 1** Complete statements concerning the ideal anesthetic agent used in anesthesiology.

a. For the __________________, the ideal anesthetic agent is rapid-acting, easily reversed, and provides analgesia extending into postoperative period.

b. For the __________________, the ideal anesthetic agent produces good muscular relaxation and minimum side effects.

c. For the __________________, the ideal anesthetic agent has a wide margin of safety, leaves the body unaltered, is potent, allows a high percentage of oxygen to be used, and has a low level of toxicity.

**OBJECTIVE 2** Complete statements concerning the preanesthetic preparation of the patient.

a. Preoperative anesthesia assessment should be made by the __________________ representative before the scheduled surgery.

b. The following tasks are performed during the preoperative visit:

- Explain the effects of the __________________.
- Inform the patient of possible ________________________________ and complications from the anesthesia
- Allow the patient to ________________________________ concerning his/her anesthetic care to alleviate possible fears.
- Perform a brief history and physical on the patient especially noting any __________________; history of liver, kidney, or heart disease, or endocrine disorders; and note the medications that the patient is currently taking.
- Evaluate the patient's __________________ and __________________ such as electrocardiogram and chest x-ray.
- May order __________________.

c. The surgical patient should ideally be __________________ for 6-8 hours prior to the induction of anesthesia to prevent __________________ and aspiration of gastric contents.

d. Preoperative medications are usually given __________________ hour(s) before surgery.

**OBJECTIVE 3** Select purposes of preoperative medications by placing an "X" in the appropriate blanks.

_______ a. To increase preoperative anxiety

_______ b. To produce some amnesia

_______ c. To increase secretions in respiratory tract

_______ d. To raise the pain threshold

_______ e. To assist in easier and smoother induction of anesthesia

_______ f. To inhibit nausea and vomiting

**OBJECTIVE 4** Complete statements concerning the selection of preoperative medications.

a. Selection is made by _________________.

b. Dependent on patient's _________________ and _________________.

c. Also dependent on _____________________________________.

**OBJECTIVE 5** Complete the statements concerning classifications of premedications by circling the correct words.

a. Sedatives and tranquilizers **(cause, do not cause)** drowsiness.

b. Sedatives and tranquilizers **(counteract, do not counteract)** pain.

c. Diazepam (Valium®) and Midazolam (Versed®) are given for their **(antiemetic, sedative)** effects.

d. Promethazine (Phenergan®), hydroxyzine (Vistaril®), and droperidol (Inapsine®) are given for their **(antiemetic, sedative)** effects.

e. Narcotic analgesics **(reduce, do not reduce)** the perception of pain.

f. Narcotics raise the pain threshold and **(decrease, increase)** the amount of anesthesia needed during the operation.

g. An example of a synthetic opiate is **(Seconal®, Demerol®, morphine sulfate)**.

h. **(Demerol®, Morphine sulfate)** is more commonly used because it produces fewer undesirable side effects.

i. Narcotics may cause nausea, vomiting, urinary retention, and depression of the **(endocrine, respiratory)** system.

j. Narcotics **(are, are not)** capable of causing dependence with regular use and **(are, are not)** classified as controlled substances by the federal government.

k. Anticholinergic drugs **(decrease, increase, have little effect on)** mucous secretions in the mouth, respiratory tract, and digestive tract.

l. Anticholinergic drugs **(decrease, increase, have little effect on)** blood pressure.

m. Anticholinergic drugs **(decrease, increase, have little effect on)** heart and respiratory rates.

n. Common anticholinergic drugs include atropine and **(Sublimaze®, Robinul®)**.

o. Reglan® is an example of an **(antacid, antiemetic)** used preoperatively.

**Objective 6** Select true statements concerning anesthesia by placing an "X" next to the true statements.

______ a. Involves the administration of potentially harmless drugs and gases.

______ b. Most general anesthetic agents are flammable.

______ c. Anesthesiologist provides skilled induction, careful maintenance of anesthesia during procedure, and prevents postoperative complications.

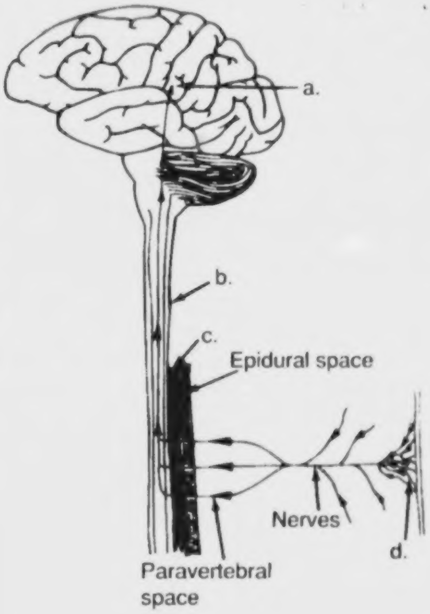
d. Anesthesiologist evaluates the following when determining type of anesthetic to use:

  ______ (1) Patient's age and general health
  ______ (2) Patient's preference
  ______ (3) Nature of the operation
  ______ (4) Laboratory and X-ray findings
  ______ (5) Pre-existing conditions or diseases
  ______ (6) In emergency surgery, time since patient's last surgery

e. Maintenance of general anesthesia involves:

  ______ (1) Deepest level of anesthesia must be maintained.
  ______ (2) Body must be deprived of oxygen.
  ______ (3) Patient remains asleep.
  ______ (4) Patient is free from pain.
  ______ (5) Muscle relaxation is not present.
  ______ (6) Autonomic reflexes are constantly monitored.

**OBJECTIVE 7** Identify sites involved in the pathway of pain by placing your answers in the blanks provided.



a. ______________________ c. ______________________

b. ______________________ d. ______________________

**OBJECTIVE 8** Distinguish among the types of anesthetics by placing the following letters in the correct blanks. Types of anesthetics may be used more than once.

"BA" for balanced anesthesia
"G" for general anesthetic
"L" for local anesthesia
"MAC" for monitored anesthesia care
"R" for regional anesthesia
"S" for spinal anesthesia

_______ a. Anesthesiologist monitors patient's vital signs and may supplement the local anesthesia with intravenous drugs that provide sedation and systematic analgesia.

_______ b. Permeates the entire body and affects all of its functions.

_______ c. Results in loss of consciousness and blockage of the pain-transmitting center of the brain.

_______ d. Anesthetic agent is injected in the spinal canal.

_______ e. Properties are produced by combining inhalation anesthetic agents with intravenous drugs.

______ f. Pain is controlled by infiltrating the surgical site with a local anesthetic.

______ g. Pain sensation is blocked at a level below the diaphragm.

______ h. Patient remains conscious.

______ i. Pain control is obtained by anesthetizing the sensory nerves in one area or region of the body.

______ j. Anesthesiologist is not involved in the case of the patient. A registered nurse monitors the patient's vital signs and administers sedation or analgesic drugs as ordered by the surgeon.

______ k. Pain control is obtained by infiltrating the surgical site with a local anesthetic.

**OBJECTIVE 9** Distinguish between methods of administering a general anesthetic by placing "INH" next to characteristic(s) of inhalation and "INT" next to characteristic(s) of intravenous.

______ a. Is injected directly into the bloodstream.

______ b. Involves breathing in anesthesia agents and oxygen which are absorbed into the bloodstream.

______ c. Is used for short surgical procedures or as an induction agent to be immediately followed by inhalation anesthesia.

**OBJECTIVE 10** List three inhalation agents and three intravenous agents used for general anesthesia.

a. Inhalation

- ______________________________
- ______________________________
- ______________________________

b. Intravenous

- ______________________________
- ______________________________
- ______________________________

**OBJECTIVE 11** List the four phases of general anesthesia.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 12**

Match stages of general anesthesia with their correct descriptions.

1. Stage I—Conscious analgesia stage
2. Stage II—Excitement stage
3. Stage III—Surgical anesthesia stage
4. Stage IV—Medullary paralysis stage

________ a. The patient is unconscious and depressed enough by the anesthetic that surgery may be performed without serious reaction by the body.

________ b. The patient is awake and has a decreased sensitivity to pain or feels no pain.

________ c. The patient is depressed severely and life support functions may be impaired. This stage may lead to the death of the patient if actions aren't taken immediately.

________ d. The patient loses his or her inhibitions and may fight or struggle briefly.

**OBJECTIVE 13**

Match types of local or regional anesthetics with their correct descriptions.

1. Bier block
2. Epidural block
3. Local infiltration block
4. Nerve block
5. Paravertebral block
6. Spinal block
7. Topical anesthesia

________ a. (1) Injected into the cerebrospinal fluid in the subarachnoid space of the lumbar region to block the roots of the spinal nerves; causes massive nerve block and muscle relaxation below the point of injection

(2) Used for surgery on lower portion of the body; injected between 3rd and 4th, or 4th and 5th lumbar vertebrae

________ b. (1) Injected just outside the dura in the epidural space

(2) Used for anesthesia of lower limbs or perineal area, and for relief of prolonged pain as with obstetrical patients

________ c. Injected near spinal nerves as they emerge through the epidural space

________ d. (1) Injected around a main nerve trunk at a site between operative site and entry of nerve into spinal cord, causing blockage of painful stimuli to the brain

(2) Used for dental work, relief of intractable pain, and procedures on extremities

________ e. (1) Intravenous injection of local anesthetic to an extremity below level of a tourniquet

(2) Used for extremity surgery that will last less than an hour

(3) Blood is drained from extremity by compression and a tourniquet is inflated; anesthetic drug is injected intravenously

________ f. (1) Injected under the skin to anesthetize the nerve endings and nerve fibers

(2) Used for minor surgery, excision of small lesions, and dental work

________ g. Directly applied to a mucous membrane to produce insensibility of the nerve endings

**OBJECTIVE 14**

List three agents used for local or regional anesthesia.

a. ______________________________

b. ______________________________

c. ______________________________

**OBJECTIVE 15**

Match other anesthetic techniques occasionally used with their correct descriptions. Techniques will be used more than once.

1. Acupuncture
2. Cryoanesthesia
3. Hypnoanesthesia
4. Hypothermia

_______ a. Involves blocking nerve conduction by means of surface cooling of a localized area

_______ b. Involves cooling of a part or the entire body

_______ c. May be used in cardiac and neurosurgery and for burns and leg amputations

_______ d. Used in topical procedures such as removal of warts and noninvasive surface lesions

_______ e. Focuses on inserting needles into meridian points on the body to stimulate the brain to release endorphins which relieve or block pain

_______ f. Produces an altered state of consciousness through the use of hypnosis

**OBJECTIVE 16**

Complete statements concerning characteristics of muscle relaxant drugs (neuromuscular blockers) by circling the correct answers.

a. Muscle relaxant drugs are used because some anesthetic gases used during a procedure render the patient unconscious but **(do, do not)** produce adequate muscle relaxation.

b. Muscle relaxants are given in conjunction with the anesthetic gas to allow the degree of muscle **(contraction, relaxation)** the surgeon needs.

c. Muscle relaxants are administered intravenously in small dosages at various intervals **(before, during)** the surgical procedure.

d. Muscle relaxants interfere with passage of impulses from **(motor, sensory)** nerves to skeletal muscles.

e. Using muscle relaxant drugs has **(eliminated, initiated)** the need for deep inhalation anesthesia to produce muscle relaxation.

f. The chief danger when using muscle relaxants is **(circulatory, respiratory)** depression.

**OBJECTIVE 17** Distinguish between the types of muscle relaxants by placing an "X" next to the characteristics of depolarizing agents.

_______ a. No antagonist is available; the drug must be allowed to wear off by itself

_______ b. Act similarly to acetylcholine, but for a longer period of time

_______ c. Do not cause muscular fasciculations

_______ d. Cause persistent depolarization that produces fasciculations followed by flaccidity

_______ e. Common agents used included tubocurarine chloride, mivacurium chloride, and pancuronium bromide (Pavulon®)

_______ f. Common agents used include succinylcholine chloride (Anectine®) and decamethonium bromide (Syncurine®)

_______ g. Antagonist used is neostigmine (Prostigmin®)

_______ h. Bind to cholinergic receptors to prevent the union of acetylcholine to the receptor

**OBJECTIVE 18** List four supplemental agents used in conjunction with oxygen to accomplish complete anesthesia.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

**OBJECTIVE 19** List two narcotic antagonists used intraoperatively.

a. ____________________

b. ____________________

**OBJECTIVE 20** Discuss the care of the anesthetized patient.

____________________

____________________

____________________

____________________

____________________

____________________

**OBJECTIVE 21** Discuss circulator and scrub personnel roles during administration of anesthesia.

a. Be aware of ____________________________________________.

b. May be asked to assist with the Sellick maneuver which involves ________________

____________________________________________.

c. When assisting anesthesia personnel with:

- General anesthesia ______________________________

  ____________________________________________

  ____________________________________________

- Spinal anesthesia ______________________________

  ____________________________________________

  ____________________________________________

- Regional anesthesia ______________________________

  ____________________________________________

  ____________________________________________

d. When dispensing local anesthesia:

____________________________________________

____________________________________________

____________________________________________

**OBJECTIVE 22** List five possible complications of anesthesia.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

d. ____________________________________________

e. ____________________________________________

**OBJECTIVE 23** Select true statements concerning malignant hyperpyrexia—malignant hyperthermia syndrome by placing an "X" in the appropriate blanks.

________ a. Is a frequent, life-threatening complication most frequently seen in children and adolescents.

________ b. It may be triggered by drugs commonly used in anesthesia.

________ c. It is a contagious disease transmitted by direct contact.

________ d. Characteristics include generalized contracture of skeletal muscles, marked temperature elevation, tachycardia, metabolic acidosis, cardiac dysrhythmia, and hypoxia.

________ e. May occur during induction or maintenance of anesthesia.

________ f. Treatment is the immediate infusion of the drug Dantrolene sodium.

________ g. Relatives of persons with malignant hyperthermia should be evaluated and tested for presence of the disease.

**OBJECTIVE 24** Complete statements concerning hemolytic reactions by

a. A hemolytic reaction occurs when ______________________________ is given to the patient.

b. When this happens, the body reacts by destroying the invading cells. Severe ________________ may result and the clotting system may be activated resulting in D.I.C. (disseminated intravascular coagulopathy) which may block the kidneys and use up the clotting factor resulting in bleeding.

c. Blood may be seen in the _______________.

d. Very ______________ blood pressure may be noted.

e. The transfusion will be _______________ and various actions taken to overcome the reaction, such as fluid administration, and the administration of drugs to support the blood pressure, renal blood flow, and treat bleeding.

f. The surgical technologist needs to be aware there is a _______________ reaction occurring and stay sterile and be ready to help as necessary. This reaction can be prevented by ensuring that the patient receives the correct blood.

**OBJECTIVE 25** Complete statements concerning anaphylactic reactions.

a. Anaphylaxis is a severe _______________ reaction. The _______________ that is released causes constriction of the airways (difficult ventilation), vascular dilation (hypotension), and leakage of fluid from the bloodstream into the intravascular spaces and lungs (lowered circulation blood volume and shock and pulmonary edema with resulting difficulty in oxygenation).

b. The anesthetist may have the patient ______________ against pressure to improve oxygenation.

c. Fluid may be given to correct _________________. Drugs may be given to increase blood pressure.

d. The surgical technologist should be aware that an anaphylactic reaction is _________________. When a patient is experiencing an anaphylactic reaction, it is important that the surgical technologist stay sterile and be ready to help as necessary.

e. Anaphylaxis can be prevented by being aware of the patient's ______________.

**OBJECTIVE 26**

Distinguish among actions of the surgical team if cardiac arrest occurs on the operating room table by placing the appropriate letters next to their actions.

"A" for Anesthesiologist
"S" for Surgeon
"CN" for Circulating nurse
"ST" for Surgical technologist/scrub nurse

________ a. If patient is hemorrhaging, keeps suction tubing and suction tips clear and functioning

________ b. Usually directs the resuscitation efforts

________ c. Maintains clear airway by suctioning, intubation, or use of a face mask to administer 100% oxygen under intermittent positive pressure

________ d. Attempts closed chest compressions

________ e. May perform open cardiac massage

________ f. Attends to the needs of the surgeon and sterile field

________ g. Has syringes of medications filled and ready to use

________ h. May do tracheostomy

________ i. Activates emergency assistance alarm

________ j. Obtains needed equipment such as defibrillator cart ("Crash Cart") and medications

________ k. Maintains accuracy of sponge and needle count

________ l. If resuscitation measures are unsuccessful, follows hospital policy in regard to death protocol

________ m. Remains sterile and protects the sterile field

________ n. Accounts for sponges, needles, and instruments

**OBJECTIVE 27**

Match OR anesthesia equipment used for delivering anesthetics and/or monitoring the patient with their correct descriptions.

_______ a. Continuous auscultation of chest sounds to detect pulmonary and cardiac sounds

_______ b. Device for visualizing and recording electrical activity of the heart

_______ c. Computers that monitor patient's vital functions; may be noninvasive or invasive

_______ d. Sensor probe clipped to a pulsating vascular bed that measures arterial hemoglobin oxygen saturation

_______ e. Special machine used to deliver oxygen and anesthetic gases to the patient through a breathing system

_______ f. Device used to monitor the patient's brain wave activity

_______ g. Device used to weigh sponges containing blood thrown from the surgical field and to estimate the amount of blood lost by the patient

_______ h. Devices that monitor patient's temperature during anesthesia using a temperature probe and any of several devices that may display patient's temperature from their skin, esophagus, rectum, blood, etc.

_______ i. May be inserted into the superior vena cava from the patient's neck to allow for the measurement of central venous pressure

_______ j. May be inserted from the patient's neck through the heart via the right atrium and ventricle and into the pulmonary artery where it measures different pressures that help the anesthetist in the care of the patient

_______ k. A monitoring device that may be connected to the anesthesia machine that checks the anesthesia gases being delivered in all the operating rooms and records and displays the data in a central location

1. Anesthesia machine with gas delivery system
2. Central venous catheter
3. E.K.G. monitor
4. Electroencephalographic device
5. Hemodynamic monitors
6. Pulmonary artery catheter
7. Pulse monitor
8. Scale
9. Stethoscopy
10. System for Anesthetic and Respiratory Analysis (SARA)
11. Temperature monitoring devices

**OBJECTIVE 28** Match equipment used as adjuncts to anesthesia with their uses.

________ a. Used to hasten fluid and blood administration by wrapping the plastic fluid or blood bag with a pneumatic device that applies pressure to the blood or fluid bag causing the liquid to flow more rapidly

________ b. Used to warm blood and fluids to body temperature before administration

________ c. Used by the anesthetist or anesthesiologist to keep local anesthetic agents in an extremity during a Bier block

________ d. Uses any of many syringe or roller pumps to help administer fluid or drug containing fluids at variable rates during the administration of anesthesia

1. Blood warming devices
2. Double-cuffed pneumatic tourniquet
3. Fluid pumps
4. Infusion control devices

**OBJECTIVE 29** List four types of thermoregulatory devices used in the operating room.

a. ________________________________

b. ________________________________

c. ________________________________

d. ________________________________

**OBJECTIVE 30** Complete statements concerning hemostasis and blood replacement.

a. Hemostatic instruments may be used to **(temporarily, permanently)** stop the bleeding to allow time for a clot to form.

b. **(Absorbable or nonabsorbable, Only an absorbable)** ligature(s) may be used to close the opening in the blood vessel.

c. Pressure may be applied to the site of the bleeding while a **(clamp, sponge)** is obtained or simply held for a few minutes while a clot forms.

d. Electric current causes **(cold, heat)** which damages the tissues resulting in physical blockage of the bleeding site.

e. Sometimes wax is placed into the bleeding edges of a(n) **(organ, bone)** to physically stop the flow of blood.

f. The surgeon may elect to use a metal hemostatic clip to occlude the flow of blood. These clips **(are, are not)** left in place after they are applied.

g. Blood or fluids that are suctioned from the operative field are usually collected in a(n) **(unmarked, calibrated)** container to aid in estimation of the amount of blood lost.

h. The anesthetist may elect to weigh the sponges containing blood that are thrown from the operative field to help estimate the volume of blood in each sponge. One cc of blood weighs approximately **(ten, one)** gram(s).

i. Auto transfusion lessens the need for **(bank blood, anticoagulants)**.

j. Blood components are stored at **(reduced, room)** temperatures and only allowed to warm when they are given.

*** Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1**

a. patient
b. surgeon
c. anesthesiologist

**OBJECTIVE 2**

a. Anesthesia
b.
- anesthesia
- side effects
- ask questions
- allergies
- laboratory data, diagnostic studies
- preoperative medication

c. NPO, vomiting
d. 1

**OBJECTIVE 3**

b, d, e, f

**OBJECTIVE 4**

a. anesthesiologist
b. Any two of the following:
- physical condition
- emotional status
- age
- weight

c. Either one of the following
- degree of relaxation necessary
- anesthesiologist's own personal preference

**OBJECTIVE 5**

a. cause
b. do not counteract
c. sedative
d. antiemetic
e. reduce
f. decrease
g. Demerol®
h. Demerol®
i. respiratory
j. are, are
k. decrease
l. have little effect on
m. increase
n. Robinul®
o. antiemetic

**OBJECTIVE 6**

c, d(1), d(3), d(4), d(5), e(3), e(4), e(6)

**OBJECTIVE 7**

a. Cerebral cortex
b. Spinal cord
c. Subarachnoid space
d. Nerve endings

**OBJECTIVE 8**

a. MAC
b. G
c. G
d. S
e. BA
f. L
g. S
h. S, R, L, MAC
i. R
j. L
k. L, MAC

**OBJECTIVE 9**

a. INT
b. INH
c. INT

**OBJECTIVE 10**

a. Any three of the following:

- Halothane (Fluothane®)
- Desflurane (Suprane®)
- Isoflurane (Forane®)
- Sevoflurane (Ultane®)
- Nitrous oxide ($N_2O$)

b. Any three of the following:

- Thiopental sodium (pentothal sodium)
- Thiamylal sodium (Surital®)
- Methohexital sodium (Brevital®)
- Propofol (Diprivan®)
- Ketamine hydrochloride (Ketalar®, Ketaject®)

**OBJECTIVE 11**

a. Induction
b. Maintenance
c. Emergence
d. Recovery

**OBJECTIVE 12**

a. 3
b. 1
c. 4
d. 2

**OBJECTIVE 13**

a. 6
b. 2
c. 5
d. 4
e. 1
f. 3
g. 7

**OBJECTIVE 14**

Any three of the following:

a. Cocaine hydrochloride (cocaine)
b. Procaine hydrochloride (Novocain®)
c. Lidocaine hydrochloride (Xylocaine®, lignocaine)
d. Tetracaine hydrochloride (Pontocaine®)
e. Mepivacaine hydrochloride (Carbocaine®)
f. Bupiviacine hydrochloride (Marcaine®, Sensorcaine®)
g. Hyaluronidase (Wydase®)

**OBJECTIVE 15**

a. 2
b. 4
c. 4
d. 2
e. 1
f. 3

**OBJECTIVE 16**

a. do not
b. relaxation
c. during
d. motor
e. eliminated
f. respiratory

**OBJECTIVE 17**

a, b, d, f

**OBJECTIVE 18**

Any four of the following:

a. Morphine sulfate
b. Fentanyl (Sublimaze®)
c. Sufentanil citrate (Sufenta®)
d. Alfentanil (Alfenta®)
e. Meperidine hydrochloride (Demerol®)
f. Diazepam (Valium®)
g. Droperidol (Inapsine®)
h. Midazolam (Versed®)

**OBJECTIVE 19**

Any two of the following:

a. Naloxone hydrochloride (Narcan®)
b. Nalbuphine hydrochloride (Nubain®)
c. Butorphanol tartrate (Stadol®)
d. Pentazocine hydrochloride (Talwin®)
e. Burenorphine hydrochloride (Buhrenex®)

**OBJECTIVE 20**

Discussion should include the following in student's own words:

a. Patients must be positioned properly to avoid pressure points, compression of nerves, or interference of respirations or circulation to an extremity. DO NOT LEAN ON THE PATIENT DURING SURGERY.
b. Change patient's position slowly and gently to allow for adjustment of circulatory system.
c. Patients must be transferred to the carrier carefully and gently to avoid straining muscles and ligaments; the anesthesiologist protects the patient's neck and head.
d. Since hearing is the last sensation to succumb to anesthesia, OR personnel must be aware that surgical patients are very vulnerable to auditory stimuli. Avoid room noise and conversations.

**OBJECTIVE 21**

Discussion should include the following in student's own words:

a. hospital policy regarding hospital personnel helping with the administration of anesthesia
b. applying pressure on the cricoid cartilage to occlude the esophagus and prevent the aspiration of stomach contents.
c. When assisting anesthesia personnel with:
    - General anesthesia—Be familiar with anesthesia equipment and procedures such as starting and connecting IVs, intubation of the patient, positioning the patient, setting up thermoregulatory devices, etc. so that you will be able to help if needed.
    - Spinal anesthesia—May be asked to set up equipment or open trays for the administration of spinal anesthesia. It may also be necessary to help position the patient for the administration of the spinal.
    - Regional anesthesia—May be asked to set up equipment and assist the anesthetist in the administration of regional anesthesia.
d. When dispensing local anesthesia, the circulator and scrub personnel may be asked to help the anesthetist draw up local anesthetic agents or they may have to draw the agents up for the anesthetist. When drawing up any medication, including local anesthetic agents, the surgical technologist should check the label on the medication with the circulating nurse, the anesthetist, or the surgeon to ensure administration of correct medication.

**Objective 22**

Any five of the following.

a. Excitement
b. Respiratory obstruction
c. Bronchospasm
d. Laryngeal spasm
e. Aspiration of stomach contents or blood into the lungs during anesthesia causing aspiration pneumonia
f. Vomiting
g. Damage to teeth or dental work
h. Eye injury due to drying of cornea or pressure from positioning
i. Reaction to drugs or blood transfusions
j. Injury to nerves due to improper positioning
k. Fluid and electrolyte imbalance
l. Hypothermia
m. Shock (neurogenic, secondary to trauma or hemorrhage)
n. Cerebral complications:
    - Cerebral vascular accident
    - Delirium
o. Cardiac arrest or cardiac arrhythmias
p. Malignant hyperthermia
q. Hypoxia

**Objective 23**

b, d, e, f, g

**Objective 24**

a. the wrong type of blood
b. hypotension
c. urine
d. low
e. stopped
f. life-threatening

**Objective 25**

a. allergic, histamine
b. exhale
c. hypotension
d. life threatening
e. allergies

**Objective 26**

a. ST
b. A
c. A
d. S
e. S
f. ST
g. ST
h. S
i. CN
j. CN
k. CN
l. CN
m. ST
n. ST

**Objective 27**

a. 9
b. 3
c. 5
d. 7
e. 1
f. 4
g. 8
h. 11
i. 2
j. 6
k. 10

**OBJECTIVE 28**

a. 3
b. 1
c. 2
d. 4

**OBJECTIVE 29**

Any four of the following:

a. Thermal drapes
b. Plastic bags
c. Hypothermia/hyperthermia blankets
d. Heat lamps
e. Fluid/blood warmers
f. Heated gas delivery
g. Hot air blankets

**OBJECTIVE 30**

a. temporarily
b. Absorbable or nonabsorbable
c. clamp
d. heat
e. bone
f. are
g. calibrated
h. one
i. bank blood
j. reduced

## Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 13

1. Which of the following is NOT an appropriate treatment for hypotension from spinal anesthesia?
   a. Place patient in head-up position to keep spinal from going higher.
   b. Give five liters/minute nasal oxygen.
   c. Infuse 200 ml. of Ringer's lactate solution quickly.
   d. Place patient in head-down position.

Objective 5

2. An example of an anticholinergic drug or combination given preoperatively to inhibit mucous secretions is:
   a. atropine and Robinul®
   b. Demerol®
   c. cocaine
   d. xylocaine 1% with epinephrine

Objective 13

3. The type of anesthetic technique in which medication is injected under the skin to anesthetize the nerve endings and nerve fibers is call a(n) _______ anesthetic.
   a. topical
   b. local
   c. epidural
   d. spinal block

Objective 22

4. What action(a) should the OR personnel be prepared to take should the patient vomit?
   a. Provide suction.
   b. Turn the patient's head to the side.
   c. Adjust table into Trendelenburg position.
   d. All of the above.

Objective 14

5. Sensorcaine® and Bupiviacine are other names for a drug used as a local anesthetic. The name of the drug is:
   a. tetracaine
   b. Pontocaine®
   c. Marcaine®
   d. Xylocaine®

Objective 21

6. When a local anesthesia is being used in the OR,
   a. A registered nurse must check the label with the surgical technologist.
   b. The circular assumes full responsibility once the anesthetic is on the sterile field.
   c. The registered nurse dispenses it directly to the surgeon.
   d. The surgeon checks the label when it is poured.

Objective 13

7. The type of anesthetic in which medication is injected in and around the main nerve trunk at a site between the operative site and entry of nerve into spinal cord, causing blockage of painful stimuli to the brain, is called a _______ type of anesthesia.
   a. nerve block or field block
   b. local
   c. epidural
   d. topical

Objective 20

8. During a gas anesthetic induction, the noise level ____________________________.
   a. is unimportant
   b. should be kept low because the sense of hearing is the last sense to be lost before the patient is rendered unconscious, and the patient is easily stimulated during Stage 2 of anesthesia
   c. must be kept down so as not to make the surgeon angry
   d. should be kept low to avoid getting in trouble with the circulating nurse

Objective 5

9. What is the the purpose of narcotic analgesics?

a. to prevent nausea

b. to prevent vomiting

c. reduce the perception of pain

d. cause drowsiness and reduce anxiety

Objective 2

10. Except in emergency situations, the minimum number of hours a patient may eat or drink prior to surgery is _______ hours.

a. may vary from institution to institution

b. 4

c. 8

d. 12

Objective 23

11. Malignant hyperthermia can be triggered by any volatile anesthetic agent, but the onset is more abrupt with ______________________________.

a. succinylcholine and halothane

b. nitrous oxide

c. pancuronium

d. dantrolene sodium

Objective 5

12. Fentanyl (Sublimaze®) is classified as a(n) _________________________.

a. barbiturate

b. narcotic

c. tranquilizer

d. anticholinergic

Objective 16

13. Muscle relaxants (neuromuscular blockers) are given during surgery to _____________________________.

a. cause paralysis

b. produce jaw relaxation during intubation

c. facilitate tissue manipulation

d. all of the above

Objective 3

14. The purpose of preoperative medication is ______________________.

    a. To produce some amnesia and raise the pain threshold
    b. To inhibit nausea and vomiting
    c. To assist in easier and smoother induction of anesthesia
    d. All of the above

Objective 3

15. After the preoperative medication, patients frequently complain of having a dry mouth. Which of the following is the best response to this problem?

    a. "Don't worry about it; you'll be going to sleep in a few minutes."
    b. "I'll get you a drink of water."
    c. Just ignore the patient.
    d. "The medication you received had something in it to make your mouth dry."

Objective 5

16. Which of the following drugs is given to treat severe bradycardia and hypotension?

    a. Lasix®
    b. calcium chloride
    c. lidocaine
    d. atropine sulfate

Objective 5

17. An example of a synthetic opiate that is most commonly used as a preoperative medication is ______________.

    a. Sublimaze®
    b. Demerol® (meperidine hydrochloride)
    c. morphine sulfate
    d. atropine

Objective 22

18. Which term indicates low or decreased blood volume?

    a. anoxemia
    b. hypovolemia
    c. hypoxia
    d. hypocalcemia

Objective 13

19. The type of local or regional anesthetic in which medication is directly applied to a mucous membrane or a specific area to produce insensibility of the nerve endings is called _______ anesthesia.

   a. epidural

   b. local

   c. topical

   d. nerve block

Objective 14

20. The most widely used medication for a local anesthesia is ________________.

   a. cocaine

   b. procaine

   c. lidocaine

   d. Marcaine®

Objective 11

21. Removal of the endotracheal tube of the anesthetized patient may initiate:

   a. bronchospasms

   b. laryngospasms

   c. vomiting

   d. all of the above

Objective 23

22. Once the diagnosis of malignant hyperthermia is made, vigorous treatment must be immediately instituted, including ____________________________.

   a. termination of anesthesia or change of technique

   b. manual hyperventilation of the patient with 100% oxygen

   c. change the soda lime canister, anesthesia hoses, and mask to eliminate traces of a triggering agent, and administration of Dantrolene

   d. all of the above

Objective 10

23. Which of the following drugs is an intravenous agent used for anesthesia induction?

   a. lidocaine

   b. Fluothane®

   c. pentothal sodium

   d. Demerol®

Objective 26

24. The surgical technologist's primary responsibility when the patient experiences cardiac arrest on the operating table is to ____________________.

a. break sterile technique and get the crash cart
b. maintain a clear airway
c. stand by to assist when needed
d. remain sterile and protect the sterile field

Objective 23

25. An anesthetic complication characterized by progressive elevation of body temperature is known as ____________________.

a. malignant hypothermia
b. malignant hypervolemia
c. malignant hypovolemia
d. malignant hyperthermia

Objective 23

26. ______________ is the drug necessary to treat malignant hyperthermia.

a. Adrenalin®
b. Dantrolene
c. Digitoxin
d. Epinephrine

Objective 27

27. Oxygen cylinders, hoses, and flowmeters are color-coded ______. Nitrous oxide cylinders, hoses, and flowmeters are color-coded ______.

a. orange, blue
b. green, blue
c. blue, green
d. gray, blue

Objective 22

28. Dark blood in the operative field may indicate that the patient is __________.

a. hyperkalemic
b. hypovolemic
c. hypotensive
d. hypoxic

Objective 13 29. Spinal and epidural anesthesia are examples of ____________________ anesthesia.

a. Bier block

b. regional

c. general

d. topical

Objective 16 30. Which of the following drugs may be given as a muscle relaxant?

a. Anectine®

b. Demerol®

c. Lidocaine

d. Morphine

Objective 30 31. ____________________ is collected from donors and contains the red blood cells and the plasma with all of the clotting factors.

a. Packed red blood cells

b. Platelets

c. Plasma

d. Whole blood

Objective 1 32. For the ______________________, the ideal anesthetic agent has a wide margin of safety, leaves the body unaltered, is potent, allows a high percentage of oxygen to be used, and has a low level of toxicity.

a. surgeon

b. patient

c. anesthesiologist

d. surgical technologist

Objective 4 33. The preoperative medication selected depends on the patient's ________________.

a. physical condition

b. emotional status

c. age

d. all of the above

Objective 2

34. Preoperative medications are usually given ____________________ before surgery.

    a. eight hours

    b. one hour

    c. ten hour

    d. fifteen minutes

Objective 6

35. Which of the following factors does the anesthesiologist consider when determining the types of anesthetic to use?

    a. any allergies that the patient may have

    b. pre-existing conditions or diseases

    c. current medications that the patient is taking

    d. all of the above

Objective 7

36. Which of the following is the correct order of the pathway of pain?

    a. nerve endings in a wound, to the nerves, through the paravertebral space, through the epidural space, through the subarachnoid space, to the spinal cord, to the cerebral cortex of the brain

    b. nerve endings in a wound, to the nerves, through the epidural space, through the paravertebral space, through the subarachnoid space, to the spinal cord, to the cerebral cortex of the brain

    c. through the paravertebral space, to the nerve endings in a wound, to the nerves, through the epidural space, through the subarachnoid space, to the spinal cord, to the cerebral cortex of the brain

    d. through the epidural space, nerve endings in a wound, to the nerves, through the paravertebral space, through the subarachnoid space, to the spinal cord, to the cerebral cortex of the brain

Objective 8

37. ________________ anesthesia results in loss of consciousness and blockage of the pain-transmitting center of the brain.

    a. Regional

    b. Spinal

    c. Local

    d. General

Objective 9

38. Which of the following are methods of administering a general anesthetic?

   a. inhalation

   b. intravenous

   c. orally

   d. both A and B

Objective 30

39. Sometimes ____________ is placed into the bleeding edges of a bone to physically stop the flow of blood.

   a. hemostatic clip

   b. ligature

   c. bone wax

   d. pharmacologic agent

Objective 6

40. Which of the following statements is TRUE concerning anesthesia?

   a. Today's general anesthetic agents are flammable.

   b. The surgical technologist provides skilled induction, careful maintenance of anesthesia during procedure, and prevents postoperative complications.

   c. Anesthesia involves the administration of potentially lethal drugs and gases.

   d. The maintenance of general anesthesia involves depriving the body of oxygen.

Objective 10

41. Which of the following is an intravenous anesthesia agent?

   a. Brevital®

   b. Suprane®

   c. Forane®

   d. Ultane®

Objective 15

42. Which of the following anesthetic techniques involves blocking nerve conduction by means of surface cooling of a localized area?

   a. hypothermia

   b. cryoanesthesia

   c. hyperthermia

   d. hypnoanesthesia

Objective 11

43. What are the four phases of general anesthesia?

a. inhalation, maintenance, extubation, recovery

b. induction, maintenance, emergence, recovery

c. administration, inhalation, extubation, trauma

d. induction, maintenance, extubation, recovery

Objective 9

44. The ________________ method of anesthesia involves breathing in vaporized liquids or gases which are absorbed into the bloodstream.

a. intravenous

b. local

c. spinal

d. inhalation

Objective 15

45. Generalized hypothermia causes a(n) ________________ in all metabolic processes with slowing of circulatory rate and a(n) ______________ of oxygen requirements.

a. increase, decrease

b. decrease, increase

c. increase, increase

d. decrease, decrease

Objective 18

46. Which of the following drugs is a tranquilizing agent used in conjunction with oxygen to accomplish complete anesthesia?

a. Versed®

b. Sublimaze®

c. Sufenta®

d. Alfenta®

Objective 16

47. The chief danger of using a muscle relaxant drug is ________________________.

a. respiratory depression

b. hypothermia

c. hyperthermia

d. bronchospasm

Objective 22

48. Which of the following is a complication of anesthesia?

    a. excitement

    b. damage to teeth or dental work

    c. fluid and electrolyte imbalance

    d. all of the above

Objective 17

49. Which of the following statements is TRUE concerning depolarizing agents?

    a. Depolarizing agents do not cause muscular fasciculations.

    b. Depolarizing agents bind to cholinergic receptors to prevent the union of acetylcholine to the receptor.

    c. No antagonist is available; the drug must be allowed to wear off by itself.

    d. Mivacron® is an example of a depolarizing agent.

Objective 26

50. If patient is hemorrhaging who keeps suction tubing and suction tips clear and functioning?

    a. surgeon

    b. circulating nurse

    c. anesthesiologist

    d. surgical technologist

Objective 18

51. Which of the following drugs is a narcotic agent used in conjunction with oxygen to accomplish complete anesthesia?

    a. Valium®

    b. Pavulon®

    c. Tracrium®

    d. Demerol®

Objective 29

52. Which of the following is a type of thermoregulatory device used in the operating room?

    a. thermal drapes

    b. double-cuffed pneumatic tourniquet

    c. ligature

    d. fluid pump

Objective 30

53. Which of the following statements is FALSE concerning auto transfusion of blood?

    a. Certain religions may not allow auto transfusions to be used.

    b. Auto transfusion is an inexpensive procedure thus should be used even when a small amount of blood loss is expected.

    c. A special suction tubing is used with auto transfusion that allows an anticoagulant to be added to the blood to prevent clot formation in the storage container.

    d. Auto transfusion lessens the need for bank blood and the dangers associated with this practice.

Objective 21

54. Which of the following statements is FALSE concerning circulator and scrub person roles during administration of anesthesia?

    a. should be aware of hospital policy regarding hospital personnel helping with the administration of anesthesia

    b. may be asked to set up equipment or open trays for the administration of spinal anesthesia

    c. may be asked to help the anesthetist draw up local anesthetic agents

    d. determines type of anesthetic to use

Objective 19

55. Which of the following drugs is a narcotic antagonist used intraoperatively?

    a. Narcan®

    b. Stadol®

    c. Buhrenex®

    d. all of the above

Objective 26

56. If cardiac arrest occurs on the operating room table, who usually directs the resuscitation efforts?

    a. surgeon

    b. circulating nurse

    c. anesthesiologist

    d. surgical technologist

Objective 27

57. Which of the following types of OR anesthesia equipment is a special machine used to deliver oxygen and anesthetic gases to the patient through a breathing system?

    a. hemodynamic monitor

    b. stethoscopy

    c. anesthesia machine with gas delivery system

    d. electroencephalographic device

Objective 30

58. An absorbable or nonabsorbable ________________ may be used to close the opening in the blood vessel.

a. hemostatic clip
b. ligature
c. bone wax
d. hemostatic instrument

Objective 28

59. Infusion control devices are used ______________________________.

a. to keep local anesthetic agents in an extremity during a Bier block
b. with syringe or roller pump to help administer fluid or drug containing fluids at variable rates during the administration of anesthesia
c. to warm blood and fluids to body temperature before administration
d. to hasten fluid and blood administration

Objective 30

60. When weighing sponges to determine patient blood loss, one cc of blood equals approximately ___________ gram(s).

a. one
b. two
c. three
d. five

Objective 12

61. In which stage of general anesthesia is the patient unconscious and depressed enough that surgery may be performed without serious reaction by the body?

a. Stage I
b. Stage II
c. Stage III
d. Stage IV

Objective 15

62. Which of the following anesthetic techniques focus on inserting needles into meridian points on the body to stimulate the brain to release endorphins which relieve or block pain?

a. hypnoanesthesia
b. acupuncture
c. cryoanesthesia
d. hypothermia

Objective 25

63. Which of the following is a severe allergic reaction?

   a. anaphylactic reaction
   b. hemolytic reaction
   c. hyperthermic reaction
   d. hypothermic reaction

Objective 24

64. Which of the following occurs when the wrong type of blood is given to a patient?

   a. anaphylactic reaction
   b. hemolytic reaction
   c. hyperthermic reaction
   d. hypothermic reaction

Objective 27

65. Which of the following may be inserted into the superior vena cava from the patient's neck to allow for the measurement of central venous pressure?

   a. pulmonary artery catheter
   b. Pezzer catheter
   c. Foley catheter
   d. central venous catheter

## Answers to Module Review

1. d
2. a
3. b
4. d
5. c
6. a
7. a
8. b
9. c
10. a
11. a
12. b
13. d
14. d
15. d
16. d
17. b
18. b
19. c
20. c
21. d
22. d
23. c
24. d
25. d
26. b
27. b
28. d
29. b
30. a
31. d
32. c
33. d
34. b
35. d
36. a
37. d
38. d
39. c
40. c
41. a
42. b
43. b
44. d
45. d
46. a
47. a
48. d
49. c
50. d
51. d
52. a
53. b
54. d
55. d
56. c
57. c
58. b
59. b
60. a
61. c
62. b
63. a
64. b
65. d

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 1-E: Computer Skills

## Module Contents

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Suggested Supplemental Resources," "Resources Used in Developing This Module," and "Suggested Web Sites" for more information.
- Make a transparency from the transparency master.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.
- Discuss and demonstrate the job sheets. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of these activities and the rating scale that will be used to indicate job performance.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the job sheets. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

  **Sample A**

  4—**Skilled**—Can perform job with no additional training.
  3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
  2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
  1—**Unskilled**—Is familiar with process, but is unable to perform job.
  0—**No exposure**—No information or practice provided during training program.

  **Sample B**

  **Yes**—Can perform job with no additional training.
  **No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.

- Make copies of, give, and evaluate the Module Review.

- Compile the Written Test, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.

- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.

- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to introduce students to basic computer operations.

- The information presented in this module is written primarily for Windows-based computer users. This is because most computers that surgical technologists will use are Windows-based.

- When discussing Objective 2, have students tour the computer lab. Point out the various types of computer equipment available.

- Demonstrate to students how to properly use the computer equipment.

- Ensure that all students have an e-mail account and address before having them complete Job Sheet 7. If they do not have an existing e-mail account, show them how to set up a free account using Yahoo or Hotmail.
- For Job Sheet 7 you may wish to have students e-mail each other to ensure that they have an unread e-mail message in order to complete the remaining steps in this job sheet.

**RESOURCES USED THIS MODULE**

- *Core Curriculum for Surgical Technology*. 5th ed. Centennial, CO: Association of Surgical Technologists, 2002.
- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Parks, Anita. *Graphic Arts: Electronic Prepress and Publishing*. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium, Inc., 2000.
- Price, Paul, and Kevin Frey. *Technological Sciences for the Operating Room*. Centennial, CO: Association of Surgical Technologists, 2002.

**SUGGESTED WEB SITES***

- http://www.microsoft.com

  This Web site contains information on the various Microsoft products. Provides specific information on Microsoft Word® which might be helpful to students who are unfamiliar with word-processing software.

- http://www.agathering.net/computer/glossary/glossary_index.html

  This site contains a glossary of computer terms.

- http://www.yahoo.com

  Yahoo! Search returns a list of web pages containing the words you entered. These results are a combination of sites from the entire Web (through third-party search engine providers) and from the Yahoo! Directory. The Yahoo! Directory is a human-created and maintained library of web sites organized into categories and subcategories. Yahoo! also offers free e-mail accounts.

- http://www.google.com

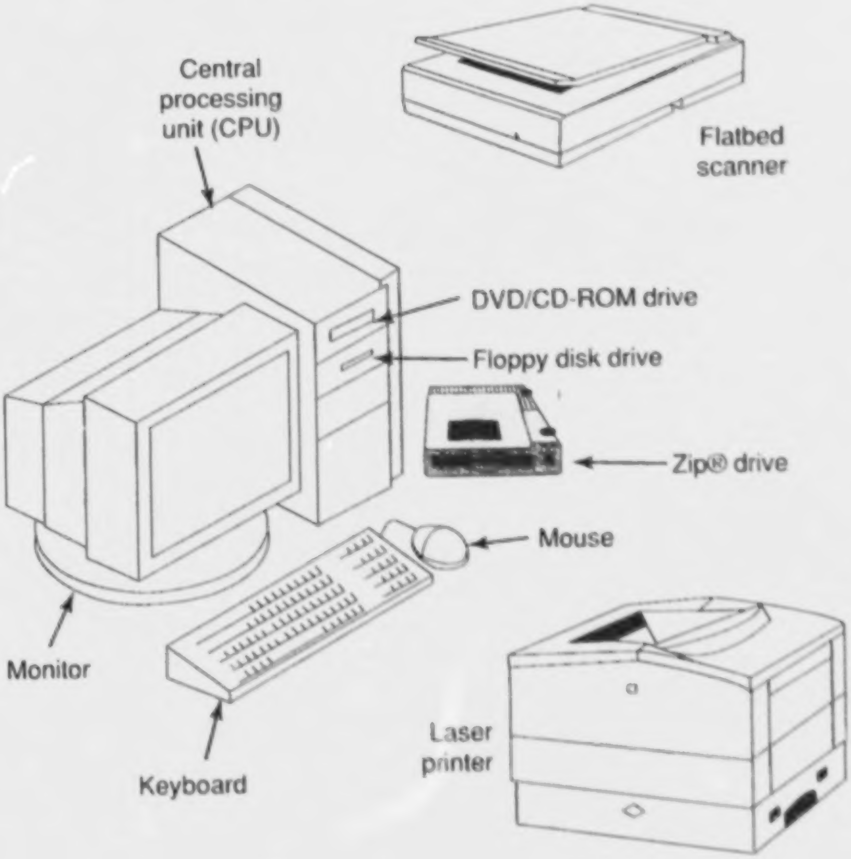
  Google is a search engine that provides links to Web sites related to the user's query. To enter a query into Google, just type in a few descriptive words and hit the 'enter' key (or click on the Google Search button) for a list of relevant web pages. Since Google only returns web pages that contain all the words in your query, refining or narrowing your search is as simple as adding more words to the search terms you have already entered. Your new query will return a smaller subset of the pages Google found for your original "too-broad" query.

- http://www.altavista.com

  AltaVista provides integrated search results to give users immediate access to relevant information including Web pages, multimedia files and up-to-the-minute news.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

# Basic Components of a Computer System


Central processing unit (CPU)
Flatbed scanner
DVD/CD-ROM drive
Floppy disk drive
Zip® drive
Mouse
Monitor
Keyboard
Laser printer

## Written Test

Name ____________________

Date ____________________ Score ____________________

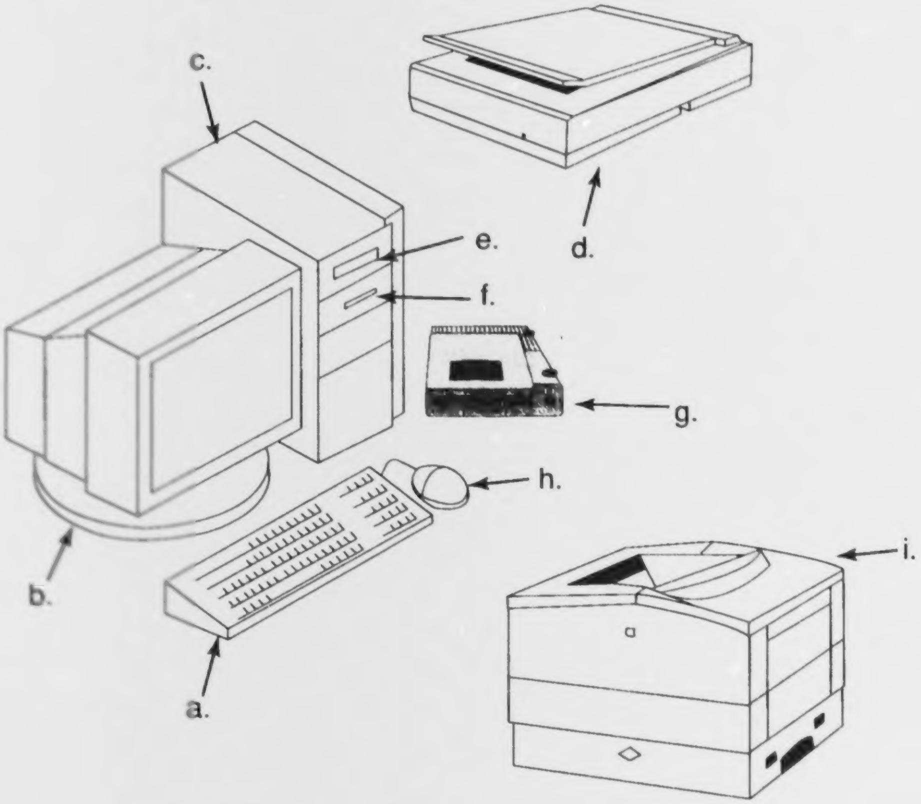
**OBJECTIVE 1** List three of the uses of computers in the surgical suite.

a. ____________________

b. ____________________

c. ____________________

**OBJECTIVE 2** Identify each of the basic components of a computer system.



a. ____________________ b. ____________________

c. ____________________ d. ____________________

e. ____________________ f. ____________________

g. ____________________ h. ____________________

i. ____________________

## Module 1-E: Computer Skills

**Objective 3** Match types of input devices on the right to their correct uses.

_______ a. Used to control the on-screen cursor or pointer when selecting items in pull-down menus, moving data, or drawing graphics in application software

_______ b. Used to enter information into the computer through the use of keys containing the alphabet, numbers, symbols, and functions

_______ c. Used to record video or still images in a digital form rather than on a film negative. Images are transferred to the computer through cables, disks, or cartridges. There is a fixed, maximum resolution that can be recorded.

_______ d. Used to convert art, photos, or text to digital data usable by the computer

1. Digital camera
2. Keyboard
3. Mouse
4. Scanner

**Objective 4** Complete the following statements concerning output devices. Write your answers on the blank lines provided in the statements below.

a. Monitors displays graphics and text on a ____________________.

b. Monitors are sold by size of screen measured ______________________ from ________________ to ____________________.

c. Speakers can be __________________ or ____________________.

d. Laser printers use intense light and toner to transfer (or draw) images on paper; supply a ___________________________ of 300 dpi or greater.

e. ___________________ printers form characters and graphics by spraying ink on paper; supplies near-laser-quality resolutions.

**Objective 5** Select true statements concerning computer memory by placing an "X" in the appropriate blanks.

_____ a. The CPU performs arithmetic and logical operations and decodes and executes instructions.

_____ b. CPUs are measured in megabytes (MB) of memory.

_____ c. The lower the MB, the faster the computer performs.

_____ d. ROM is temporary memory that stores data and programs while the computer is in use.

_____ e. RAM is used by the computer's operating system and ensures that the system memory runs.

**OBJECTIVE 6** Match computer storage devices on the right to their correct descriptions.

_______ a. Device used to read from and write information to floppy diskettes

_______ b. Mechanism designed to turn a CD in the presence of a laser beam and photo diode detector to read information encoded on the CD

_______ c. Storage device that uses some type of disk or cartridge for storing and transporting large files such as documents containing graphics

_______ d. Device used to read DVDs and CDs

_______ e. Device used to read, write, and store data on a hard, magnetic disk located inside the computer

1. CD-ROM drive
2. DVD drive
3. Floppy disk drive
4. Hard drive
5. Removable drive

**OBJECTIVE 7** Distinguish between basic computer operating systems by placing a "W" next to the description of a Windows operating system.

_____ a. Provides a graphics-based operating environment for PC users

_____ b. Designed for Apple's numerous personal computer models

**OBJECTIVE 8** Match terms related to the computer desktop on the right to their correct descriptions.

_______ a. A row, column, or block of on-screen buttons or icons that activate certain functions when clicked on with the mouse

_______ b. Location where deleted files are stored until emptied

_______ c. On-screen work area that uses icons and menus to simulate the top of a desk; enables users to move pictures of objects and to start and stop tasks

_______ d. Area that displays all programs currently open; contains start menu from which computer programs can be opened and new software can be loaded; contains the settings menu from which numerous computer preferences may be changed

_______ e. Instructions that make the computer perform the tasks for which people use computers; designed to assist in the performance of a specific task

_______ f. Background design of desktop

1. Desktop
2. Program
3. Recycle bin
4. Taskbar
5. Toolbar
6. Wallpaper

**OBJECTIVE 9**

List four of the characteristics of word-processing software.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 10**

Match basic word-processing software text-tool operations on the right to their correct functions.

_______ a. To mark text so that it will be removed from its current position, temporarily stored in the computer's memory, and then retrieved in another position

_______ b. To delete, insert, or rearrange text

_______ c. To input text

_______ d. To rearrange an area of text that is defined by boundaries

_______ e. To mark text so that it will be left in its current position, while a copy is temporarily stored in the computer's memory, and then retrieved in another position

1. Copy and paste text
2. Cut and paste text
3. Edit text
4. Move or adjust text
5. Type text

**OBJECTIVE 11**

Match page-setup features on the right to their correct descriptions.

_______ a. Dialog box for creating either equal- or unequal-size column positions and numbers

_______ b. Permanent page formats that can be copied and used repeatedly

_______ c. Dialog box for setting left, right, top, and bottom page limits

_______ d. Page numbering within a document

_______ e. Dialog box for selecting either portrait (tall) or landscape (wide) page position

_______ f. Text placed either at the bottom of a page or at the end of a document to show resources used in creation of document

1. Columns
2. Footnotes and endnotes
3. Margin settings
4. Page orientation
5. Pagination
6. Templates

**OBJECTIVE 12** Match paragraph-specification features on the right to their correct functions.

_______ a. Option selected to adjust the placement of text around graphics

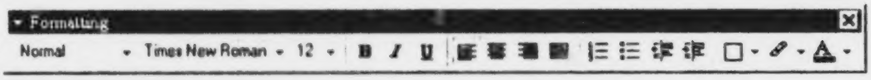
_______ b. Options selected to align text lines in specific increments left, right, center, decimal, or dot leader

_______ c. Option selected to position text flush left, flush right, centered, or justified

_______ d. Options selected to make either global or individual changes to a selection including hyphenation, alignment, space before and after, and indents

1. Alignment
2. Paragraph-specifications
3. Tabs and indents
4. Text wrap

**OBJECTIVE 13** Identify the primary functions of the icons located on a word-processing toolbar.

| Functions | Icons | Functions | Icons |
|---|---|---|---|
| a.__________ | 📂 | f.__________ | ✂ |
| b.__________ | 🗋 | g.__________ | 📋 |
| c.__________ | 💾 | h.__________ | 🖌 |
| d.__________ | 🖨 | i.__________ | ↶ |
| | | j.__________ | 100% ▾ |
| e.__________ |  | | |

BEST COPY AVAILABLE

**OBJECTIVE 14** Complete the following statements concerning the basics of using the Internet.

a. You must have an account with an ________________________ to access the Internet.

b. In order to access the Internet, your computer must have Internet _______________ software installed.

c. The ____________ page is the first page that appears when the Internet browser is opened.

d. The ________________ and ________________ buttons allow the user to move back and forth between pages in a Web site.

e. The ________________ button is used to reload the page the user is currently viewing.

f. The ______________ button discontinues loading the current page.

g. The ______________________ allows the user to save a web address in their browser for viewing at a later time.

h. When conducting research on the Internet, use a ___________________ to search for specific topics.

**OBJECTIVE 15** Select true statements concerning e-mail by placing an "X" in the appropriate blanks.

_____ a. To send and receive e-mail, you must have an e-mail address.

_____ b. E-mail addresses are composed of a personalized name/user ID followed by the @ symbol and then the Internet/e-mail provider name.

_____ c. Composing, sending, receiving, forwarding, and deleting are some common e-mail functions.

_____ d. Names and e-mail addresses are stored in the address book.

***Permission to duplicate this test is granted.**

## Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 1-E: Computer Skills

### Answers to Written Test

**Objective 1**

Any three of the following. Answers may appear in any order.

a. To schedule patients in surgery
b. To save, update, and print surgeon's preference cards
c. To save and update surgical patient's charts
d. To save surgical records, such as lab reports
e. To order supplies and maintain inventory from sterile processing department
f. To perform surgical procedures involving robotics

**Objective 2**

a. Keyboard
b. Monitor
c. Central processing unit (CPU)
d. Flatbed scanner
e. CD-ROM/DVD drive
f. Floppy disk drive
g. Zip® drive
h. Mouse
i. Laser printer

**Objective 3**

a. 3
b. 2
c. 1
d. 4

**Objective 4**

a. screen
b. diagonally; corner; corner
c. internal; external
c. resolution
d. Inkjet

**Objective 5**

a, b

**Objective 6**

a. 3
b. 1
c. 5
d. 2
e. 4

**Objective 7**

a

**OBJECTIVE 8**

a. 5
b. 3
c. 1
d. 4
e. 2
f. 6

**OBJECTIVE 9**

Any four of the following. Answers may appear in any order.

a. Allows input of large amount of text
b. Provides formatting features, such as setting tabs and margins
c. Provides editing features, such as moving, copying, inserting, and deleting text
d. Provides a spell-check feature
e. Provides a thesaurus to search for synonymous words
f. Provides a grammar check
g. Provides search-and-replace feature for words, letters, numbers, and phrases
h. Provides a merge feature to individualize documents, such as form letters, by combining the document file with data files, such as names and addresses

**OBJECTIVE 10**

a. 2
b. 3
c. 5
d. 4
e. 1

**OBJECTIVE 11**

a. 1
b. 6
c. 3
d. 5
e. 4
f. 2

**OBJECTIVE 12**

a. 4
b. 3
c. 1
d. 2

**OBJECTIVE 13**

a. Open file
b. Create a new file
c. Save a file
d. Print
e. Formatting
f. Cut
g. Copy
h. Paste
i. Undo
j. Zoom

**OBJECTIVE 14**

a. Internet Provider (IP)
b. browser
c. home
d. Forward; Back
e. Refresh (or Reload)
f. Stop
g. Bookmarks (or Favorites)
h. search engine

**OBJECTIVE 15**

a, b, c, d

## Answers to Assignment Sheets

**Assignment Sheet 1**

Assignment should be evaluated to satisfaction of instructor.

**Assignment Sheet 2**

Assignment should be evaluated to satisfaction of instructor according to word-processing software located on-site.

## Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 14

1. You must have an account with an Internet ______________ to access the Internet.
    - a. browser
    - b. provider
    - c. search engine
    - d. e-mail service

Objective 10

2. Which of the following describes the function of the cut and paste text feature of word-processing software?
    - a. to input text
    - b. to delete, insert, or rearrange text
    - c. to mark text so that it will be removed from its current position, temporarily stored in the computer's memory, and then retrieved in another position
    - d. to mark text so that it will be left in its current position, while a copy is temporarily stored in the computer's memory, and then retrieved in another position

Objective 2

3. Which of the following is NOT a basic component of a computer system?
    - a. monitor
    - b. central processing unit
    - c. robot
    - d. DVD/CD-ROM drive

Objective 3

4. What type of software is used to scan text?

   a. word-processing
   b. optical character recognition (OCR)
   c. spreadsheet
   d. page-layout

Objective 15

5. Which of the following is a correct example of an e-mail address?

   a. johndoe@yahoo.com
   b. cab73734-pldi.com
   c. surgtech1*yahoo.com
   d. mavcc#1.hotmail.com

Objective 11

6. A ____________________ is a permanent page format that can be copied and used repeatedly.

   a. footnote
   b. document
   c. template
   d. file

Objective 6

7. What is the maximum amount of data that can be stored on a CD?

   a. 760 K to 2.8 MB
   b. 7 GB
   c. 100–250 MB
   d. 650–700 MB

Objective 4

8. The density of dots or pixels on a page or monitor usually measured in dots per inch is called ________________________.

   a. resolution
   b. pixelation
   c. monitor size
   d. printer quality

Objective 5

9. A megabyte is equal to 1,024 ______________.

   a. kilobytes
   b. gigabytes
   c. bytes
   d. terabytes

Objective 14

10. What allows the user to save a web address in their browser for viewing at a later time?

   a. bookmarks
   b. favorites
   c. home page
   d. both a and b

Objective 3

11. How are images transferred from a digital camera to a computer?

   a. through cables
   b. through disks
   c. through cartridges
   d. all of the above

Objective 5

12. What is usually called the "brain" of the computer?

   a. CPU
   b. RAM
   c. ROM
   d. REM

Objective 7

13. What type of computer program is responsible for housekeeping and establishing communications between disk the storage device, computer, and printer and tells the computer how to manipulate information?

   a. operating system
   b. word-processing software
   c. spreadsheet software
   d. page-layout software

Objective 6

14. What type of computer storage device is used to read, write, and store data on a hard, magnetic disk located inside the computer?

    a. CD-ROM drive
    b. DVD drive
    c. hard drive
    d. floppy disk drive

Objective 13

15. Which of the following functions is/are located on a word-processing toolbar?

    a. open file
    b. create a new file
    c. save a file
    d. all of the above

Objective 9

16. Word-processing software provides a ________________ to check for synonymous words.

    a. spell-check feature
    b. grammar check feature
    c. thesaurus
    d. search-and-replace feature

Objective 4

17. What type of printer uses intense light and toner to transfer images on paper?

    a. inkjet
    b. dot matrix
    c. color
    d. laser

Objective 8

18. Computer _____________________ are instructions that make the computer perform the tasks for which people use computers and assist in the performance of a specific task.

    a. software
    b. programs
    c. icons
    d. both a and b

Objective 9

19. Which of the following is NOT a characteristic of word-processing software?
    a. allows input of large amount of text
    b. provides formatting features
    c. provides a merge feature
    d. provides spreadsheet feature

Objective 6

20. A DVD drive can also read ________________.
    a. floppy disks
    b. Zip® disks
    c. Jaz® disks
    d. CDs

Objective 14

21. The ________________ button reloads the page the user is currently viewing.
    a. refresh
    b. stop
    c. home
    d. bookmarks

Objective 5

22. What is temporary memory that stores data and programs will the computer is in use called?
    a. Read Only Memory
    b. Central Processing Unit
    c. Random Access Memory
    d. Megabyte Only Memory

Objective 1

23. Which of the following are uses of computers in the surgical suite?
    a. to schedule patients in surgery
    b. to save surgical records
    c. to perform surgical procedures involving robotics
    d. All of the above

Objective 11

24. What is the purpose of footnotes and endnotes?

    a. to number pages within a document
    b. to document resources used in creation of report
    c. to provide place for student to take notes
    d. none of the above

Objective 8

25. Deleted files are stored in the ____________________ until emptied.

    a. recycle bin
    b. wallpaper
    c. toolbar
    d. start menu

Objective 12

26. To position text flush left, flush right, centered, or justified are all examples of text ______________________.

    a. wrap
    b. alignment
    c. hyphenation
    d. pagination

Objective 14

27. A(n) ___________________ is a Web site that helps the user conduct a search for a specific topic.

    a. Internet browser
    b. e-mail engine
    c. search engine
    d. e-mail browser

Objective 8

28. The _________________ is a row, column, or block of on-screen buttons or icons that activate certain functions when clicked on with the mouse.

    a. taskbar
    b. recycle bin
    c. toolbar
    d. desktop

Objective 7

29. ________________ operating system provides a graphics-based operating environment for PC users.

a. Macintosh

b. Unix

c. Windows

d. none of the above

Objective 14

30. ____________________ is an example of Internet browser software.

a. Netscape Navigator®

b. Internet Explorer®

c. Yahoo!

d. both a and b

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. b
2. c
3. c
4. b
5. a
6. c
7. d
8. a
9. a
10. d
11. d
12. a
13. a
14. c
15. d
16. c
17. d
18. d
19. d
20. d
21. a
22. c
23. d
24. b
25. a
26. b
27. c
28. c
29. c
30. d

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 2-E: Electricity

Introduction to Surgical Technology
Section E: Biomedical Science
Module 2-E: Electricity

## Module Contents

**COMPONENTS**

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Suggested Supplemental Resources," "Resources Used in Developing This Module," and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheet. Review with students the criteria for evaluation of this activity.
- Discuss and demonstrate the job sheet. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of these activities and the rating scale that will be used to indicate job performance.

**EVALUATION**

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.

- Evaluate the job sheet. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

  **Sample A**

  4—**Skilled**—Can perform job with no additional training.
  3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
  2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
  1—**Unskilled**—Is familiar with process, but is unable to perform job.
  0—**No exposure**—No information or practice provided during training program.

  **Sample B**

  **Yes**—Can perform job with no additional training.
  **No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

✔ **NOTE:** This module's purpose is to teach students about electricity as it relates to surgical technology.

- When discussing Objective 2, provide the students with a copy of the periodic chart.
- Show students an electrosurgery system to illustrate Objectives 19 through 21. Explain the function of each component as you are showing it.
- Explain the differences between bipolar and monopolar electrosurgery units as explained in Objective 21.

- Spend considerable time reviewing and explaining the safeguards for using electrosurgery units as presented in Objective 22. Demonstrate on a dummy the correct way to prep the patient and place the dispersive electrode in relationship to the ECG electrodes. Discuss the toxic hazards presented by laser plumes and electrosurgery smoke.

**RESOURCES USED THIS MODULE**

- *Core Curriculum for Surgical Technology*. 5th ed. Centennial, CO: Association of Surgical Technologists, 2002.
- Henderson, G.E. *Understanding Electricity and Electrical Terms*. 8th ed. Athens, GA: American Association for Vocational Instructional Materials, 1993.
- *Introduction to Surgical Technology*. 2nd ed. Stillwater, OK: Mid-America Academic and Vocational Curriculum Consortium, 1994.
- Patrick, Dale R., and Stephen W. Fardo. *Understanding Electricity and Electronics*. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1989.
- Price, Paul, and Kevin Frey. *Technological Sciences for the Operating Room*. Centennial, CO: Association of Surgical Technologists, 2002.
- Turner, J. Howard. *Understanding Electricity and Electrical Terms*. Winterville, GA: American Association for Vocational Instructional Materials.

**SUGGESTED WEB SITES***

- http://www.smud.org/safety/world/site_files/science/basics.html

  This Web site explains the basics of electricity, how it is generated, how it travels, how it is measured, etc.

- http://66.45.30.237/static/pofe/pofes.htm

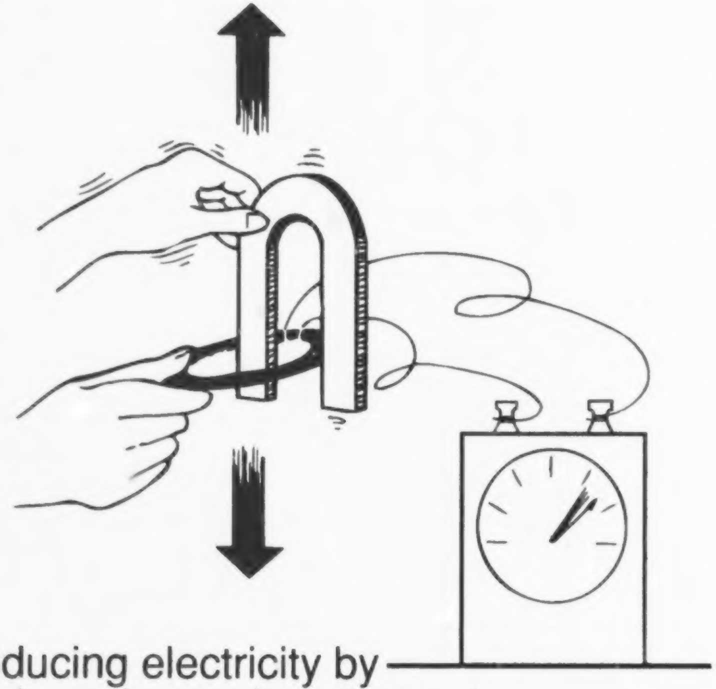
  This online educational booklet on electrosurgery is provided by Valleylab. This site contains excerpts from the many educational programs available from Valleylab, an accredited provider of both nursing and physician continuing medical education.

- http://www.gelighting.com/eu/institute/firstlight/module01/01.html

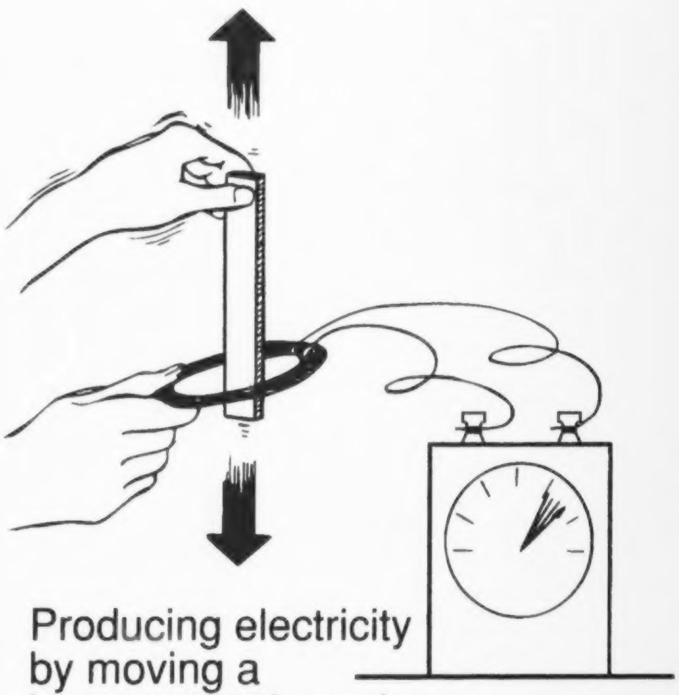
  General Electric offers this online module on the basics of electricity. It contains information on what electricity is, how electric current flows, Ohm's Law, what constitutes a complete electrical circuit, types of electricity, differences between single-phase and three-phase supplies, etc.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

# Magnetism Produces Electricity



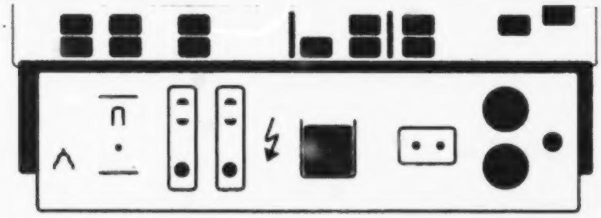
Producing electricity by moving a horseshoe magnet through a coil of wire



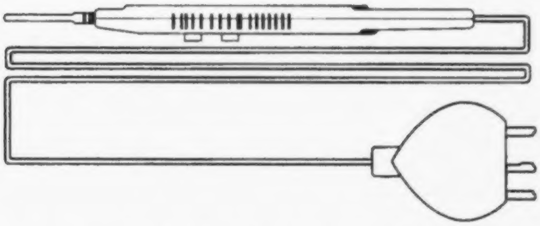
Producing electricity by moving a bar magnet through a coil of wire

This principle is used in generators.

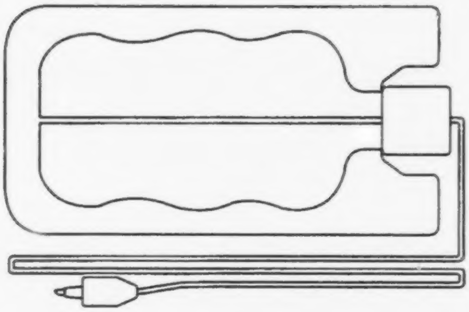
# Components of an Electrosurgery System



Generator



Active electrode



Dispersive (inactive) electrode

## Written Test

Name ______________________________

Date ________________ Score ________________

**OBJECTIVE 1** Define the term *electricity*. Write your answer on the blank lines provided below.

**Electricity**—______________________________

______________________________

**OBJECTIVE 2** Complete the following statements concerning the structure of matter. Write your answers on the blank lines provided in the statements below.

a. Matter is anything that occupies ____________ and has ____________.

b. Matter can be a ____________, ____________, or ____________.

c. All matter is made up of ____________, such as nitrogen, oxygen, iron, etc.

d. There are over ____________ elements in the periodic table of elements.

e. Two or more elements combined make up what is called a ____________.

f. ____________ can be broken down into molecules.

g. Molecules are made up of ____________.

**OBJECTIVE 3** Select true statements concerning the principles of electron flow by placing an "X" in the appropriate blanks.

_____ a. Atoms contain protons, electrons, and neutrons.

_____ b. Protons always have a negative charge.

_____ c. Electrons always have a positive charge.

_____ d. Neutrons always have a neutral charge.

_____ e. The nucleus is the center of an atom and consists of protons and neutrons.

_____ f. Electrons orbit around the nucleus of an atom.

_____ g. Insulators are materials through which electrons flow easily.

_____ h. Conductors are materials or substances that resist electron flow.

_____ i. Copper, aluminum, and zinc are all good conductors.

_____ j. By wrapping an insulating material around a conductor, the current is prohibited from passing to other conductors.

_____ k. Generation occurs when an outside force of power excites the electron flow and electricity is produced.

**OBJECTIVE 4**

Complete the following statements concerning the basic sources of electrical generation. Write your answers on the blank lines provided in the statements below.

a. ________________ produces electricity when two materials are rubbed together.

b. ________________ produces electricity when ____________ is applied to crystalline substances such as quartz or tourmaline.

c. ________________ produces electricity when it is applied to the junction of two dissimilar metals.

d. ________________ produces electricity when it strikes a photosensitive material.

e. ________________ action produces electricity when that action takes place between two metals in a cell.

f. __________________ produces electricity when a magnet is moved past a piece of wire.

**OBJECTIVE 5**

Select the true statements concerning magnetism by placing an "X" in the appropriate blanks.

_____ a. Magnets consist of iron, cobalt, or copper.

_____ b. Each end of a magnet is referred to as a pole. One end is the north pole and the other end is the south pole.

_____ c. A magnetic field occurs when two magnets are placed end to end.

_____ d. When the north pole is put to the south pole, they repel.

_____ e. When the south pole and south pole are aligned, they attract.

_____ f. Magnetic attraction varies with pole strength and distance.

_____ g. A magnet is composed of lines of power, called flux lines, around the magnetic field.

**OBJECTIVE 6**

Complete the following statements concerning electromagnetism. Write your answers on the blank lines provided in the statements below.

a. Electromagnetism occurs because of electrical ____________________________.

b. Electromagnets are used to generate ___________________, store memory on computers, generate images on a television screen, and diagnose illnesses.

c. Electromagnetism is formed when an electric current through a ___________ generates a magnetic field.

**OBJECTIVE 7** Match terms related to electrical current on the right to their correct descriptions.

_______ a. Refers to alternating current and the rate that it changes from a positive to a negative pattern of movement

_______ b. The rate as determined by the generating force

_______ c. An electrical current flowing in one direction only and substantially constant in value

_______ d. An electrical current flowing in two directions; it flows in one direction, stops, and then flows in the opposite direction

1. Alternating current (AC)
2. Cycle
3. Direct current (DC)
4. Frequencies

**OBJECTIVE 8** Select true statements concerning measuring electricity by placing a "X" in the appropriate blanks.

_____ a. Amperes are used to measure electrical pressure that is applied to force electrons through a circuit.

_____ b. Ampere ratings on equipment indicate the amount of current needed to operate the equipment properly.

_____ c. Volts are used to measure the intensity of the electron flow in a circuit.

_____ d. For a current to flow in a conductor, a force must be applied at one end. This electron-pushing force is called the electromotive force.

_____ e. Ohms are used to measure electrical resistance.

_____ f. The amount of resistance is determined by the substance that makes up the conductor, size of the conductor, and the length of the conductor.

_____ g. When supplying electricity to various outlets in an operating room, the more current the wires must carry and the distance it is carried, the larger the wire size should be.

_____ h. Watts are used to measure electric power.

_____ i. Combining volts and amperes produces a measurement of power.

**OBJECTIVE 9** State Ohm's law.

**Ohm's law**— ____________________________________________

____________________________________________

**OBJECTIVE 10** State the formula for Ohm's law.

____________________________________________

**OBJECTIVE 11** List the uses of Ohm's law.

a. ____________________

b. ____________________

c. ____________________

**OBJECTIVE 12** Match the wires contained in an electrical receptacle on the right with their correct descriptions.

| | | |
|---|---|---|
| _______ | a. The wires that are connected to the neutral bar of the power supply and can sometimes serve as a ground; usually white or light gray in color | 1. Ground wire |
| _______ | b. This wire is provided as a safety for the piece of equipment it operates. It can be distinguished normally as a bare copper wire or a medium green wire. | 2. Hot wire |
| _______ | c. The wires that are connected to the power supply or source; usually black, red, and blue in color | 3. Neutral wire |

**OBJECTIVE 13** Complete the following statements concerning wall outlets and plugs commonly used in the operating room. Write your answers on the blank lines provided in the statements below.

a. Wall outlets used in operating rooms are normally ____________ V.

b. Grounded outlets are used in operating rooms to automatically ground equipment when plugged into an outlet to reduce risk of ________________.

c. Grounded outlets have a ____________ receptacle for the ground prong on a plug.

d. ____________-pronged plugs are primarily used in electrical equipment found in the operating room. This prong serves as the grounded plug.

**OBJECTIVE 14** List four of the primary equipment used in surgery that requires electricity to function.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

**OBJECTIVE 15** List the major causes of electrical accidents.

a. ____________________

b. ____________________

c. ____________________

**OBJECTIVE 16**

Complete the following statements concerning facts about electrical shock. Write your answers on the blank lines provided in the statements below.

a. High ______________ tends to knock the victim away from the ______________, minimizing exposure time.

b. High ______________ tends to cause the body to adhere to the ______________, so that the victim cannot let go.

- At about ________ milliampere, a single shock will be felt.
- At about ________ milliamperes, the shock is severe enough to paralyze muscles, and a person may not be able to let go of the conductor.
- At about ________ milliamperes, the shock is usually fatal if it lasts 1 second or more.

**OBJECTIVE 17**

Select true statements concerning static electricity by placing an "X" in the appropriate blanks.

_____ a. Static electricity is a rare hazard in the O.R.

_____ b. Static electricity causes patient shocks and burns.

_____ c. Static electricity produces a spark which can ignite materials in oxygen rich atmosphere of the O.R.

_____ d. Static electricity develops from friction and accumulates on physical objects.

_____ e. When two static-bearing objects come in contact, the one bearing the higher potential discharges to the one with the lower potential.

_____ f. An electrostatic charge or spark between two objects can occur only when there is no pathway of conductivity between them. Therefore, the chief aim is to provide a manner of dissipating the static accumulation.

_____ g. A good conductive floor prevents the accumulation of static electricity by providing a pathway of conductivity between all persons and equipment coming in contact with it.

_____ h. Oils, waxes, and detergents increase the conductivity of floors and should always be used in the operating room.

**OBJECTIVE 18**

Complete statements concerning grounding operating room electrical equipment. Write your answers on the blank lines provided in the statements below.

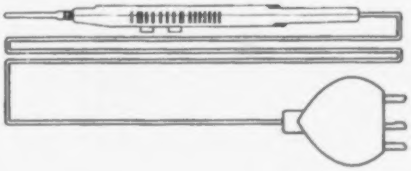
a. All electrical equipment, including ____________________, must be grounded to prevent the leakage of stray current.

b. When an instrument or piece of equipment is properly grounded, leakage current returns to the earth, via the ______________________, causing no damage.

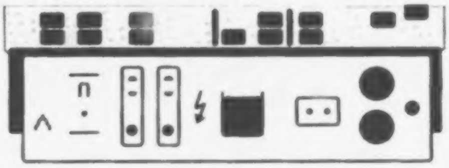
c. If the ground path is interrupted by ______________________________, leakage current will seek another path to ground, and this alternate path may be through O.R. personnel.

**OBJECTIVE 19**

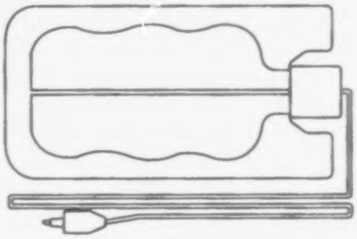
Identify the components of an electrosurgery system. Write the correct answer in the blanks provided below.



a. ______________________



b. ______________________



c. ______________________

**OBJECTIVE 20**

Match electrosurgery components to their descriptions. Write the numbers on the blanks provided.

_____ a. Machine that produces the power for the active electrode to coagulate or cut tissue

_____ b. Site that disperses the current released through the active electrode and provides a return from the tissues at the operative site back to the generator

_____ c. Sterile handpiece that directs the flow of current from the generator to the tissues at the operative site

1. Active electrode
2. Dispersive electrode
3. Generator

**OBJECTIVE 21** Distinguish between types of electrosurgery units. Place an "X" next to the description of a bipolar unit.

_____ a. The current does not disperse itself through the patient; thus a grounding pad is NOT necessary.

_____ b. An inactive dispersive electrode must be used to "ground" the patient. This is accomplished through the patient grounding pad/plate that is placed in direct contact with the skin.

**OBJECTIVE 22** Complete statements concerning safeguards for using electrosurgery units. Write your answers on the blank lines provided in the statements below.

a. Place dispersive electrode

- As close as possible to the ____________________,
- To cover as ______________ a surface area as possible, and
- On a clean, hair-free, scar-free area.

b. Do not place dispersive electrode on skin over a ______________.

c. Make sure that the connection between the dispersive electrode and the generator is ________________.

d. Ensure that the metal connection between pad or plate and conductor cord ___________________ the patient.

e. Do not use ____________________________________ with electrosurgery.

f. Do not use electrosurgery on the ________________________ when high concentrations of oxygen or nitrous oxide are used.

g. Place ECG electrodes _____________________________ the operative site as possible to avoid diversion to an alternate ground site.

h. Know that connecting a bipolar active electrode to a monopolar receptacle may activate current and cause a ____________________.

i. Know that a(n) __________________ can occur if electrical sparks ignite flammable gases or solutions.

j. Use ________________________ to prevent fire.

k. Investigate a repeated request to increase the "power" or "current"; the dispersive electrode or connecting cord may be _______________.

l. Know that contact with the 110/120 volt 60 Hz input power can cause ____________________________.

m. Keep the electric cautery tip in a ___________________ when it is not being used.

n. Be alert: Know that most incidents involving electrosurgical units are caused by ____________________________.

o. To minimize noxious odors and/or potential toxic effects of electrosurgical smoke, wear a ________________________________________ during procedures that generate laser plume, surgical smoke, or aerosol.

p. Evacuate laser plume, electrosurgery smoke, and noxious fumes through a ____________________________________, so that hazardous particles do not become airborne and deposit in the respiratory tracts of the surgical team.

q. Avoid using ____________________________ for plume capture, because of possible future deterioration of vacuum systems and low-volume situations preventing full capture of the plume at the surgical site.

***Permission to duplicate this test is granted.**

## Answers to Written Test

**OBJECTIVE 1** A form of energy related to the atomic structure of matter; invisible energy

**OBJECTIVE 2**

a. space; weight
b. solid, liquid, gas
c. elements
d. 100
e. compound
f. Compounds
g. atoms

**OBJECTIVE 3** a, d, e, f, i, j, k

**OBJECTIVE 4**

a. Friction
b. Pressure; pressure
c. Heat
d. Light
e. Chemical
f. Magnetism

**OBJECTIVE 5** b, c, f, g

**OBJECTIVE 6**

a. current flow
b. electricity
c. wire

**OBJECTIVE 7**

a. 2
b. 4
c. 3
d. 1

**OBJECTIVE 8** b, d, e, f, g, h, i

**OBJECTIVE 9** The current in an electric circuit equals the pressure (volts) divided by the resistance

## Module 2-E: Electricity

**Objective 10**

Volts = Amps x Ohms

**Objective 11**

a. Calculating circuit resistance
b. Calculating circuit amperage
c. Calculating circuit voltage

**Objective 12**

a. 3
b. 1
c. 2

**Objective 13**

a. 110
b. electrocution
c. round
d. Three

**Objective 14**

Any four of the following. Answers may appear in any order.

a. Electrical monitoring equipment
b. Electrosurgical systems (Bovie)
c. Endoscopes
d. Lasers
e. Robotics
f. Video equipment/computers
g. X-ray machines

**Objective 15**

Answers may appear in any order.

a. Rushed or distracted personnel (carelessness)
b. Failure to verify that equipment was deenergized
c. Misuse of tools or equipment

**Objective 16**

a. voltage; circuit
b. current, circuit
    - 1
    - 10
    - 100

**Objective 17**

c, d, e, f, g

**Objective 18**

a. Any one of the following: heart monitors, defibrillators, x-ray machines, electrosurgical units, and electrical saws and drills
b. ground
c. Any of the following: broken or frayed cords, plugs, or defective equipment

**Objective 19**

a. Active electrode
b. Generator
c. Dispersive (inactive) electrode

**Objective 20**

a. 3
b. 2
c. 1

**Objective 21**

a

**Objective 22**

a.
  - operative site
  - large

b. metal implant
c. secure
d. does not touch
e. flammable anesthetics
f. Any of the following: mouth, around the head, or in the pleural cavity
g. far away from
h. short circuit
i. explosion
j. moist sponges
k. detached
l. Either of the following: electric shock or even death by electrocution
m. holster
n. personal error
o. high-filtration surgical mask
p. filter device and smoke evacuation system
q. wall vacuum lines

## Answers to Assignment Sheet

**Assignment Sheet 1**

1. Potential hazards include injury to patient and danger to the staff. Other hazards may be listed and should be evaluated according to the satisfaction of the instructor.
2. Answer should be evaluated according to the satisfaction of the instructor.
3. Answer should be evaluated according to the satisfaction of the instructor.
4. Correct way to unplug equipment is to pull the plug not the cord.

## Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 21

1. Which of the following is characteristic of a bipolar electrosurgery unit?
   a. The current flows from generator to active electrode through patient to inactive electrode and then back to generator.
   b. A patient grounding pad must be used to ground the patient.
   c. A patient grounding pad is not necessary.
   d. An inactive dispersive electrode must be used.

Objective 6

2. Electromagnets are used to:
   a. generate electricity
   b. store memory on computers
   c. diagnose illnesses
   d. all of the above

Objective 12

3. The ____________ wire is provided as a safety for the piece of equipment it operates.
   a. hot
   b. neutral
   c. ground
   d. negative

Objective 8

4. Which of the following measures the intensity of the electron flow in a circuit?
   a. ampere
   b. voltage
   c. ohm
   d. watt

Objective 18

5. Which of the following statements is TRUE concerning grounding operating room electrical equipment?

   a. If the ground path is interrupted by broken or frayed cords, plugs, or defective equipment, leakage current will seek another path to ground, and this alternate path may be through operating room personnel.

   b. When an instrument or piece of equipment is properly grounded, leakage current returns to the earth, via the ground, causing no damage.

   c. Electrical equipment used in operating rooms does not need to be grounded.

   d. Both a and b

Objective 5

6. What do magnets consist of?

   a. iron, cobalt, or nickel

   b. iron, copper, or zinc

   c. copper, zinc, or magnesium

   d. copper, nickel, or zinc

Objective 1

7. Which of the following is the correct definition for electricity?

   a. a form of energy related to the atomic structure of matter; invisible energy

   b. invisible energy

   c. anything that occupies space and has weight

   d. both a and b

Objective 6

8. An electromagnet is created when a ____________ is wrapped around a ___________ object.

   a. cord; plastic

   b. string; rubber

   c. wire; metal

   d. wire; rubber

Objective 4

9. Which of the following is a basic source of electrical generation?

   a. friction

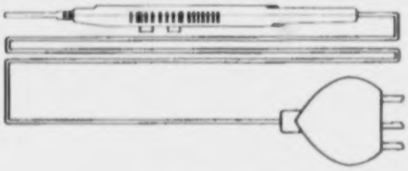
   b. heat

   c. magnetism

   d. all of the above

Objective 19

10. What component of an electrosurgery system is shown below?



a. generator

b. active electrode

c. static electrode

d. dispersive electrode

Objective 2

11. Which of the following statements concerning matter is TRUE?

a. Matter can be a solid, liquid, or gas.

b. Matter is anything that occupies space and has weight.

c. All matter is made up of elements.

d. All of the above

Objective 7

12. Flashlights and automobile engines are examples of which of the following?

a. alternating current (AC)

b. direct current (DC)

c. radio frequency

d. hertz

Objective 22

13. Which of the following statements concerning electrosurgery is FALSE?

a. Smoke created by electrosurgery is not as dangerous as smoke created by lasers.

b. Contact with the 110/120 volt 60 Hz input power of an electrosurgery unit can cause electric shock or even death by electrocution.

c. Electrosurgery should not be used on the mouth, around the head, or in the pleural cavity when high concentrations of oxygen or nitrous oxide are used.

d. Electric cautery tips should be kept in a holster when not being used.

Objective 2

14. There are over __________ elements in the periodic table of elements.

a. 100

b. 200

c. 300

d. 400

Objective 2

15. Two or more elements combined make up what is called ________________.

    a. matter

    b. a compound

    c. a molecule

    d. an atom

Objective 11

16. Which of the following is Ohm's law used to calculate?

    a. circuit resistance

    b. circuit amperage

    c. circuit voltage

    d. all of the above

Objective 20

17. Which part of an electrosurgery system directs the flow of current from the tissues at the operative site back to the generator?

    a. generator

    b. active electrode

    c. static electrode

    d. dispersive electrode

Objective 3

18. What do atoms contain?

    a. protons, electrons, and neutrons

    b. protons, electrons, and neurons

    c. photons, electrons, and neurons

    d. protons, electrodes, and neutrons

Objective 3

19. Protons always have a ______________ charge.

    a. positive

    b. negative

    c. neutral

    d. positive and negative

Objective 17

20. Which of the following statements is FALSE concerning static electricity?

a. Static electricity causes the patient shock or burns.

b. Static electricity produces a spark which can ignite materials in the oxygen rich atmosphere of the operating room.

c. Static electricity develops from friction and accumulates on physical objects.

d. Static electricity is a common hazard in the operating room.

Objective 3

21. Which of the following statements are TRUE concerning conductors?

a. Conductors are materials through which electrons flow easily.

b. A current-carrying device such as a wire is an example of a conductor.

c. Copper, aluminum, silver, zinc, and brass are all good conductors.

d. All of the above

Objective 5

22. When the north pole of a magnet is put to the south pole, they ___________.

a. repel

b. don't do anything

c. spark

d. attract

Objective 22

23. Which of the following is NOT a correct way to place the electrosurgery dispersive electrode?

a. as close as possible to ECG electrodes

b. as close as possible to the operative site

c. to cover as large a surface area as possible

d. on a clean, hair-free, scar-free area

Objective 7

24. Which of the following is TRUE concerning alternating current?

a. flows in two directions

b. flows in one direction, stops, and then flows in the opposite direction

c. flows in one direction only

d. both a and b

Objective 20

25. The sterile handpiece that directs the flow of current from the generator to the tissues at the operative site is called the ________________.

    a. generator
    b. active electrode
    c. dispersive electrode
    d. inactive electrode

Objective 8

26. The formula for power is Power = Amps or Current x __________.

    a. Ohms
    b. Watts
    c. Hertz
    d. Volts

Objective 10

27. Which of the following is the formula for Ohm's law?

    a. Volts = Amps x Ohms
    b. Current = Amps ÷ Resistance
    c. Resistance = Volts x Amps
    d. Power = Amps x Volts

Objective 3

28. Neutrons always have a ____________ charge.

    a. positive
    b. negative
    c. neutral
    d. positive and negative

Objective 12

29. The hot wire is usually __________________ in color.

    a. white or light gray
    b. green
    c. yellow
    d. black, red, and blue

Objective 13

30. The third prong of a plug used in an operating room is the ______________ plug.

a. grounded
b. neutral
c. positive
d. negative

Objective 2

31. Which of the following statements are TRUE?

a. Molecules are made up of atoms.
b. Compounds can be broken down into atoms.
c. One molecule of water contains two hydrogen atoms and one oxygen atom.
d. All of the above

Objective 15

32. Electrical accidents are usually caused by which of the following?

a. rushed or distracted personnel
b. misuse of tools or equipment
c. failure to verify that equipment was deenergized
d. all of the above

Objective 3

33. Electrons always have a ______________ charge.

a. positive
b. negative
c. neutral
d. positive and negative

Objective 14

34. Which of the following is NOT an example of equipment used in surgery that requires electricity to function?

a. scalpel
b. lasers
c. robotics
d. X-ray machines

Objective 3

35. Insulators are materials or substances that ______________ electron flow.

    a. conduct
    b. resist
    c. allow
    d. excite

Objective 16

36. At about ______________ milliampere, electrical shock is severe enough to paralyze muscles, and a person may not be able to let go of the conductor.

    a. 1
    b. 10
    c. 100
    d. 1,000

Objective 9

37. Which of the following is Ohm's law?

    a. Current in an electric circuit equals the pressure divided by the resistance
    b. Current in an electric circuit equals the voltage divided by the pressure
    c. Current in an electric circuit equals the pressure multiplied by the resistance
    d. Current in an electric circuit equals the voltage multiplied by the pressure

Objective 3

38. The ______________ is the center of an atom and consists of protons and neutrons.

    a. nucleus
    b. neuron
    c. photon
    d. mitochondria

Objective 8

39. Which of the following determines the amount of electrical resistance?

    a. substance that makes up the conductor
    b. size of the conductor
    c. length of the conductor
    d. all of the above

Objective 21

40. Which of the following is a correct description of a monopolar electrosurgery unit?

   a. allows the current to flow only between the tips of the active electrode and then returns to the generator

   b. current does not disperse through the patient, thus a grounding pad is not necessary

   c. current flows from generator to active electrode, through the patient, to an inactive dispersive electrode, and then back to generator

   d. none of the above

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. c
2. d
3. c
4. a
5. d
6. a
7. d
8. c
9. d
10. b
11. d
12. b
13. a
14. a
15. b
16. d
17. d
18. a
19. c
20. a
21. d
22. d
23. a
24. d
25. b
26. d
27. a
28. c
29. d
30. a
31. d
32. d
33. b
34. a
35. b
36. b
37. a
38. a
39. d
40. c

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 3-E: Applied Physics

## Module Contents

**COMPONENTS**

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.

**TEACHING SUGGESTIONS**

- Obtain a centrifuge from your local hospital. You may opt to include an additional job sheet, or you may want to do this in class as a demonstration. You may also opt to use real blood, should you be able to obtain some. Or, you may want to use the blood volume lab suggested by Rodriguez and Cameron at http://www.coe.tamu.edu/~alliance/p-bloodvol_lab.html using paint thinner, oil and water.

- When discussing Objectives 5 through 7, experiment with fulcrum for class 1, 2 and 3, using typical equipment on a Mayo tray. Compare this with skeletal movements by having students perform a curl, push-up and lateral lift as described in Student Supplement 1.
- When discussing muscular motion in Objective 7, have two objects, one light and another heavy. Have students lift each when the arm is locked to the side of the body and then when it is extended fully out.
- Another activity that reinforces Objective 7 has students create all three movement categories: translational, rotational and vibrational. This can include using screws for rotational work and simple periodic motion using a spring or a pendulum. (See pages 28–30 of Webster and Robertson's *Medical and Biological Physics.*)
- To reinforce DOF in Objective 7, check out the animated clip of a robot at http://www.ite.his.se/ite/research/automation/course/gripper.htm.
- When discussing light in Objectives 22 through 24, borrow several endoscopes from your local hospital to have on hand for display. Be sure to have at least one laser and one fiber.
- Visit the following Web site when discussing Objectives 18 through 20. Experiments that answer the question, "What is electricity?" can be found at http://www.duboismarketing.com/whatiselec.htm.
- When discussing magnetism in Objective 20, have an example of a standard magnet and ferrous iron, and then a magnet that "floats."
- Many of the assignment sheets in this module contain questions that are fairly advanced. Review the assignment sheets to determine if you would like for students to answer all or only selected questions.

**RESOURCES USED IN DEVELOPING THIS MODULE**

**Books**

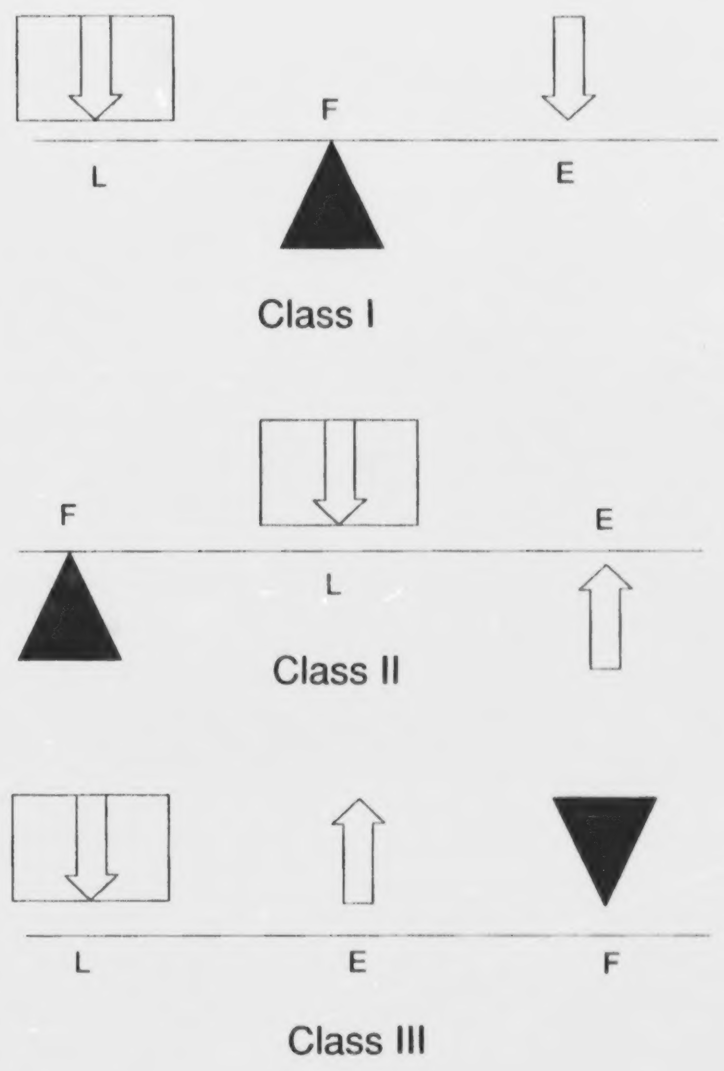
- Andrade, Joseph, ed. *Medical and Biological Engineering in the Future of Health Care.* Salt Lake City, UT: University of Utah Press, 1994.
- Cember, Herman. *Introduction to Health Physics.* New York: McGraw-Hill, 1996.
- Flitter, Hessel H. A*n Introduction to Physics in Nursing.* St. Louis, MO: C.V. Mosby, 1976
- Hobbie, Russell K. *Intermediate Physics for Medicine and Biology.* New York: Springer-Verlag, 1997.
- McAnish, T.F., ed. *Physics in Medicine and Biology Encyclopedia.* Oxford, UK: Pergamon Press, 1986.
- Stacy, Ralph W., et al. *Essentials of Biological and Medical Physics.* New York: McGraw-Hill, 1955.
- Stanford, A.L. *Foundations of Biophysics.* New York: Academic Press, 1975.
- Webster, H.C. and D.F. Robertson. *Medical and Biological Physics.* Brisbane, Australia: Watson, Ferguson and Co., 1961.

**SUGGESTED WEB SITES***

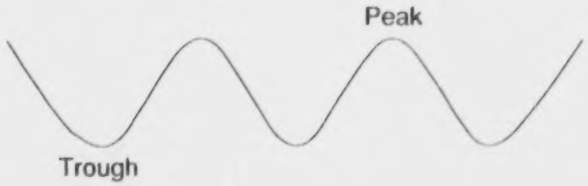
- www.yogadoctor.com/principles.html
- www.colorado.edu/physics/2000/waves_particles/wavpart2.html
- http://tooldoc.wncc.nevada.edu/rticks.pdf
- http://tooldoc.wncc.nevada.edu/joints.htm
- www.macalester.edu/~psych/whathap/UBNRP/Imaging/images.html
- www.chemistry.ohio-state.edu/~woodward/ch121/ch1_intro.htm
- www.darvill.clara.net/emag/emagxray.htm
- http://imagers.gsfc.nasa.gov/ems/ems.html
- www-texdev.mpce.mq.edu.au/GOLDYS/ou2/node1.html

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

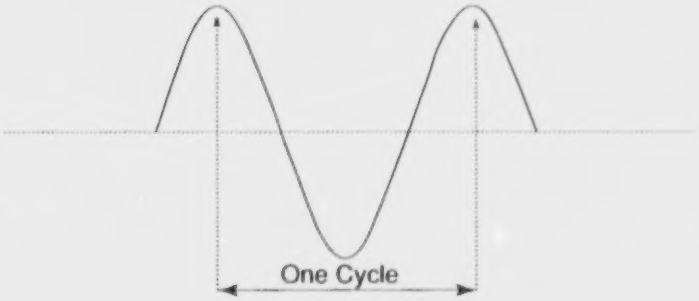
# Classes of Levers


F
L
E
Class I
F
E
L
Class II
L
E
F
Class III

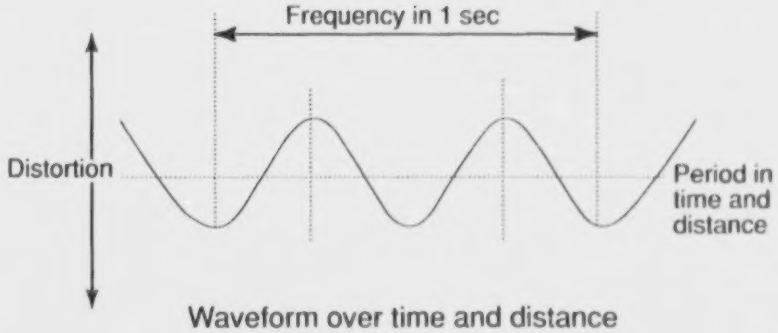
# Waveforms


Peak
Trough

Waveform crest and trough



Waveform cycle


Frequency in 1 sec
Distortion
Period in time and distance

Waveform over time and distance

## Written Test

Name ______________________________

Date ________________ Score ________________

**OBJECTIVE 1** Distinguish among gravitational, magnetic, and electrical forces by placing a "G" next to the effects of gravitational force, an "M" next to the effects of magnetic force, and an "E" next to the effects of electrical force.

_______ a. Used to relocate organs out of the way by turning or tipping patient on surgical bed

_______ b. Can "pull" or "push"

_______ c. Used to guide catheters through internal body passages

_______ d. Requires a conductor

_______ e. Quantity of force depends on the output of power

_______ f. Used in probes to detect internal anomalies

_______ g. Considered a "pull"

_______ h. Used for nervous and muscular disorders

**OBJECTIVE 2** Complete the following statements concerning pressure. Write your answers on the blank lines provided in the statements below.

a. Pressure results from a given amount of ________________ being exerted in a specific area

b. Pressure is generally measured in ______________________________ and ______________________________

c. Points of ________________ pressure always flow to points of ________________ pressure.

d. A point of pressure in liquids or gases results in an increase in pressure on the ________________ side and a decrease on the ________________ side similar to watching the ripples after a stone is dropped in water; a wave.

e. The greater the pressure, the sharper the waves and the longer the duration before the wave propagation drops back to ________________.

f. The standard pressure of the atmosphere on earth at sea level is 76.0 cm or 760.0 mm Hg. ______________________________ is also measured in these terms.

g. Normal pressure also supports a column of water approximately 34 ft. high. ____________________ are measured in these terms.

h. Any rise above normal atmospheric pressure is _________________ pressure.

i. Any drop below normal atmospheric pressure is ________________ pressure.

j. Most medical equipment is geared towards _______________ pressure.

**OBJECTIVE 3** Match Newton's three laws of motion to their correct descriptions.

_______ a. Inversely proportional to mass

_______ b. If an object is at rest, it remains so; if an object is in motion, it stays in motion

_______ c. For every action, there is an equal and opposite reaction

1. Acceleration
2. Force pair
3. Inertia

**OBJECTIVE 4** Explain why blood separates in a centrifuge. Write your answer on the blank lines provided below.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

**OBJECTIVE 5** Select true statements concerning types of simple machines by placing an "X" in the blanks next to the true statements.

_____ a. Levers are used to lift, pull, or push objects; force is applied to a fairly rigid structure that moves around a fixed pivot point.

_____ b. Levers always consist of a fulcrum, load, and effort.

_____ c. In a Class I lever, the resistance is between the fulcrum and the effort.

_____ d. In a Class II lever, the resistance is between the fulcrum and resistance.

_____ e. In a Class III lever, the fulcrum is placed between effort and resistance.

_____ f. Surgical scissors and retractors are examples of Class I levers.

_____ g. Thumb forceps are example of Class III levers.

_____ h. An inclined plane is at an angle between a horizontal and vertical difference, usually to overcome a step or vertical difference.

_____ i. A wedge is a modified inclined plane.

_____ j. The wheel and axle consist of a wheel with a hole in the center, into which an axle is threaded.

_____ k. Pulleys employ a wheel with a grooved rim into which a chain or rope fits.

**OBJECTIVE 6** Explain the center of gravity and its effect on posture and approach to work. Write your answer on the blank lines provided below.

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**OBJECTIVE 7** Complete the following statements concerning the modes of motion. Write your answers on the blank lines provided in the statements below.

a. For translational and angular movement, the X-axis moves from __________ to __________.

b. ______________ is a turning of x degrees.

c. Vibration is a(n) ________________.

d. Physics have proven that muscles function best and are at their optimal strength when at _____________ of their total possible tension.

**OBJECTIVE 8** Select true statements concerning the composition of matter by placing an "X" in the blanks next to the true statements.

_____ a. Molecules are groups of atoms held together in specific patterns and shapes.

_____ b. Matter is composed of a collection of atoms.

_____ c. There are three basic building blocks of the molecule: the electron, proton and photon.

_____ d. Electrons repulse.

_____ e. Protons repulse.

_____ f. Normally, there are an equal number of protons and neutrons in the atom so that the energy is balanced.

_____ g. Molecules are constantly moving.

_____ h. Compounds consist of only one kind of atom type.

_____ i. The properties that elements and compounds possess are both physical and chemical.

**OBJECTIVE 9**

Select true statements concerning matter's three changes of state by placing an "X" in the blanks next to the true statements.

_____ a. In solids, the molecules are strongly attracted to each other and are very close together, often moving through oscillation.

_____ b. In liquids, the molecules are only weakly attracted to one another, and in some cases, hardly at all. They are dispersed and quite far apart with very active motion.

_____ c. In gases, the molecules are moderately attracted to one another and are further apart, moving freely.

_____ d. Changes in state are generally accompanied by a change in temperature and a change in pressure.

_____ e. Solutions are a mixture of particles that dissolve in a solvent or dissolving medium.

_____ f. True solutions generally contain particles settled in the medium.

_____ g. Suspensions are a mixture of particles where some particles dissolve and others do not dissolve in a medium.

_____ h. Cornstarch cooked in liquid or on a solid or foam are examples of colloidal dispersions.

**OBJECTIVE 10**

Complete the following statements concerning heat transfer. Write your answers on the blank lines provided in the statements below.

a. ________________________ is the passive transfer of heat as it passes through a substance.

b. ________________________ is the movement of heat from a solid to liquids such as water or gases such as air.

c. ________________________ is the movement of heat energy.

d. The body's response to ____________________ results in a rise in blood pressure, hallucinations, loss of bodily fluids, and death of cells.

e. The body's response to ____________________ results in a fall in blood pressure, rising levels of carbon dioxide and respiratory constriction, drop in urinary and intestinal production. diminished activity in the brain and nervous system, and metabolic acidosis.

f. __________________ heating or heat transfer can heal.

g. Therapeutic heat allows more blood to __________ and muscles to ____________.

h. Dry heat and steam heat are used in sterilizers and autoclaves to ________________________.

i. Focused heat, such as laser surgery, can ______________ abnormal tissues or actually ___________________ tissue (tissue ablation).

**OBJECTIVE 11** Explain how cryosurgery works and its advantages. Write your answer on the blank lines provided below.

**OBJECTIVE 12** Complete the following statements concerning a waveform. Write your answers on the blank lines provided in the statements below.

a. Waveforms are created through a change in ______________ that pushes molecules together.

b. With the compaction of molecules, there is a change in ____________, a deformation.

c. The molecules transmit the change or energy by ____________ or colliding with one another.

d. Wave displacement can be measured by ____________ or ____________.

e. The ________________ of a water wave is visible, but many waves are not visible to the human eye.

f. The ____________ or ____________ is the high point of the wave.

g. The ____________ is the low point of a wave.

h. The distance between one wave crest and the next wave crest or the length of a cycle is ______________________.

i. The magnitude of the crest and trough, measured from the midline, is called ______________ or __________________.

j. The bigger or taller the ________________, the louder the sound. Conversely, the smaller the amplitude, the softer the sound.

k. ______________ is measured in time. For light, a ____________ can be measured in time or distance. For sound, a ____________ is measured in 1 second intervals.

l. The measure of the interval of the wave from peak to peak is called ____________. The number of times the wavelength repeats within a time period is usually measured in cycles per second or cps.

m. Understanding what occurs during ________________ is the most critical for understanding ultrasound.

n. ________________ occurs when the wave bends or changes course. It may be caused by changes in speed. Doppler relies on this.

o. ______________ or ducting are commonly used for endoscopic tools.

**OBJECTIVE 13** Describe how ultrasounds work. Write your answer on the blank lines provided below.

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**OBJECTIVE 14** Explain how Doppler ultrasound works. Write your answer on the blank lines provided below.

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**OBJECTIVE 15** Complete the following statements concerning the dual nature of light. Write your answers on the blank lines provided in the statements below.

a. Light acts as a ______________.

b. Light waveforms have their own brightness and color, determined by ________________ and ___________________.

c. The only color seen by human eyes is the color that is ________________ back and not _________________.

d. Light also acts as a particle of energy which can be measured in ______________.

e. In our solar system, the _________ is our primary source of electromagnetic energy.

f. Light energy is measured in terms of ____________________.

**OBJECTIVE 16** Match the electromagnetic spectrum types on the right to their correct uses.

_______ a. Used in the treatment of tuberculosis and exfoliation in skin conditions like psoriasis. Also used as a counterirritant to lumbago and neuritis. It is also used for its ability to sterilize against bacteria, viruses and other microorganisms.

_______ b. Used in diagnosis and treatment. Fluoroscopy uses ingested or injected special substances or chemicals that glow for observing muscular, vascular or intestinal tract movements.

_______ c. Used in thermography to graphically present temperature information and to perform vascular and muscular evaluations. Also used to treat some forms of cancer.

1. Infrared radiation
2. Ultraviolet radiation
3. X-ray radiation

**OBJECTIVE 17**

Select true and false statements concerning magnetism characteristics by placing an "X" in the blanks next to the true statements.

______ a. Magnets have one side that is attracted to the north pole and one side that is attracted to the south pole.

______ b. When two magnets are brought close together, north and south repel one another.

______ c. The region around the magnet is called the magnetic field.

______ d. Using a magnet with certain substances can convert that substance into a permanent magnet.

______ e. Electric fields surround magnetic fields.

______ f. The heart's magnetic field is much weaker than the brain's magnetic field, which is weaker than the lung's magnetic field.

**OBJECTIVE 18**

Distinguish between static and dynamic electricity by placing an "S" next to the descriptions of static electricity and a "D" next to the descriptions of dynamic electricity.

_____ a. Generated by radiant, thermal, chemical or mechanical energy

_____ b. Generated through friction and an accumulation of charges on a surface

_____ c. A passive by-product of forces

_____ d. Thermoelectricity is an example of this type of electricity

**OBJECTIVE 19**

Complete the following statements concerning electricity and electric current. Write your answers on the blank lines provided in the statements below.

a. Electricity is the result of the ______________ of charges, which can exist in nature or be manufactured.

b. Most electricity is generated using water, ______________, wind or ______________ power.

c. Current is the movement of electrons from the ______________ charged side through a conductor to the ______________ charged side.

d. The body's electrical fields are much ______________ than its magnetic fields.

**OBJECTIVE 20**

List two physical and two biological effects of electric current that prove helpful in medicine. Write your answers on the blanks provided below.

Physical effects

a. ____________________________________________

b. ____________________________________________

Biological effects

c. ______________________________

d. ______________________________

**OBJECTIVE 21**

Complete the following statements concerning fiber optics. Write your answers on the blank lines provided in the statements below.

a. Optical fiber is a narrow filament of spun ______________ or even transparent ______________.

b. Light most often travels down conventional optical fiber bundles of light-conveying glass or plastic. It is very ______________, so the light bounces back and forth down the filament without dispersing.

c. The primary use of fiber is to deliver ______________.

d. Light sent down a fiber bundle is used to view ______________.

**OBJECTIVE 22**

Describe how optical fiber is used in endoscopic surgery. Write your answer on the blanks provided below.

**OBJECTIVE 23**

Complete the following statements concerning the use of lasers in surgery. Write your answers on the blank lines provided in the statements below.

a. Lasers produce a beam of light that spans the ______________, visible and UV portion of the electromagnetic spectrum.

b. Lasers rely on exciting lots of ______________ activity at once, so that they all travel in the same direction, with the same energy and identical ______________.

c. For lasers, the beam of light is generally sent down an articulated or flexible hollow tube that guides the ______________.

d. Lasers can also be used as a surgical tool, when ______________ instead of being dispersed, to divide tissue, to destroy tissue, and to fix tissue together in adhesion.

**OBJECTIVE 24**

Match laser types on the right to their correct descriptions.

_______ a. Second generation laser using neon and helium in a glass tube

_______ b. Commonly used and similar in function to the original ruby laser, but through a YAG tube, which is much more efficient and can be tuned

_______ c. Third generation laser, gaining in power through the use of molecular gas, a nuclear reaction

_______ d. Uses single, synthetic ruby rod between the polarizer and the telescope

_______ e. Nuclear through the use of molecular gas. In this instance, the gas is contained in a graphite or beryllium oxide plasma tube and requires extensive water or air-cooling, respectively.

1. Argon and Krypton laser
2. Carbon dioxide laser
3. Helium-neon laser
4. Neodymium Yttrium-aluminum-garnet laser
5. Ruby laser

**OBJECTIVE 25**

Select true statements concerning uses for nuclear medicine in surgery by placing an "X" in the blanks next to the true statements.

_____ a. A structural diagnosis alters, changes or affects the function of a specific organ or tumor or growth.

_____ b. A functional diagnosis defines shape, size and edges of the object.

_____ c. Radiotherapy is radiation exposure through exposure, inhalation and ingestion or injection.

_____ d. A CAT or CT scan are cross-sectional images that track how energy is absorbed by magnetic nuclei when exposed to a static magnetic field passed over the body.

_____ e. NMRS and p or cNMRS scans are similar to MRI, but must have a "homogenous" magnetic field for the entire sampling.

_____ f. A PET scan and SPECT scan measure emissions of special nuclear tracers (isotopes) that have been injected into the blood stream and then travel to the brain. Brain activity is then recorded, digitized and converted into a three-dimensional map of the brain or organ.

_____ g. EEG and MEG scans record the activity in the brain in response to some sort of stimulus.

_____ h. An FMR is similar to an MRI, but an FMR records the functions of the organ, instead of its structure. It can track neural activity, blood flow, oxygen levels, etc.

**OBJECTIVE 26**

Complete the following statements concerning CT scans. Write your answers on the blank lines provided in the statements below.

a. CT slices were originally ____________, proceeding to X-ray on the x-axis, then the y-axis.

b. Next, a wider fan-like beam and a wide-angled detector ________________ slightly around the object.

c. Finally, full _______________ with a circular ring detector and a circular _______________ of the X-ray completely surrounded the entire object.

d. Linear or back-projection CT scans are X-ray slices that are taken at ___________ angles on a linear or flat plane.

e. ____________ or __________ CT scans are X-ray slices that are taken as the source and detector rotate around the patient while moving along the gantry on the X-axis.

**OBJECTIVE 27**

Complete the following statements concerning the importance of setting and measuring irradiation dosage. Write your answers on the blank lines provided in the statements below.

a. The International Commission on Radiological Protection (ICRP) is an organization that sets safety standards for ______________________________.

b. ICRP makes recommendations for ________________________ safety, including quantity of exposure and the regulation of medical exposure, both to practitioners and those being treated.

c. Set by the ICRP and MIRD Committee standards for diagnostic and ____________________ use.

d. The ____________________ used must minimize harmful effects and maximize therapeutic effects.

e. Limits intake through exposure, inhalation, and _____________________.

f. An excessive external or internal dose can cause _________________.

g. External dosages are due to radiation __________________ of the body, through natural, intentional and unintentional exposure

h. Internal dosages include irradiation that is absorbed through the skin, ___________________ or inhaled.

i. The recommended Annual Limit of Intake (ALI) for the general public is _______________ per year; occupational exposure is ____________- per year effective whole body dose; medical exposure not to exceed the __________________________ benefit to patient.

j. The _________________________ is the most sensitive organ to irradiation.

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**OBJECTIVE 28**

List three primary methods of protecting against occupational irradiation. Write your answers on the blank lines provided below.

a. ______________________________

b. ______________________________

c. ______________________________

*Permission to duplicate this test is granted.

## Answers to Written Test

**Objective 1**

a. G
b. M
c. M
d. E
e. E
f. M
g. G
h. E

**Objective 2**

a. force
b. PSI (pounds per square inch); GSC (grams per centimeter)
c. greater; lesser
d. advancing; retreating
e. equilibrium
f. Blood pressure
g. Cerebrospinal fluids
h. positive
i. negative
j. negative

**Objective 3**

a. 1
b. 3
c. 2

**Objective 4**

Answers should be in student's own words and should include the following:

Hematocrits use centrifugal force, where an object, in this case a test tube with blood in it, is whirled in a circular path. Because of the imbalance of force, which shifts with the circular movement, there is a strong outward pull on the blood in the tube. As the pull becomes stronger, the blood begins to separate into its heavier and lighter components.

**Objective 5**

a, b, f, g, h, i, j, k

**Objective 6**

Answers should be in student's own words and should include the following:

Center of gravity in people shifts with movement. Correct posture keeps the body balanced. Standing, walking, lifting, reaching and leaning all require a focus on good balance and an awareness of the body's center of gravity.

**Objective 7**

a. left; right
b. Rotation
c. oscillation
d. half

**Objective 8**

a, b, d, f, g, i

**Objective 9**

a, d, e, h

**Objective 10**

a. Conduction
b. Convection
c. Radiation
d. hyperthermia
e. hypothermia
f. Intentional
g. flow; loosen
h. destroy bacteria
i. destroy; vaporize

**Objective 11**

Answers should be in student's own words and should include the following:

Cryosurgery freezes the water in tissue. The tissue that is frozen is destroyed. Cold does not denature proteins the way heat does, so the sheaths of nerves remain intact and can regenerate sensation in the affected tissue.

**Objective 12**

a. pressure
b. shape
c. vibrating
d. distance; time
e. oscillation
f. crest; peak
g. trough
h. wavelength
i. distortion; amplitude
j. amplitude
k. Period; period; period
l. frequency
m. reflection
n. Refraction
o. Channeling

**Objective 13**

Answers should be in student's own words and should include the following:

Ultrasound scans measure and record high-frequency sounds projected into a segment of the human body. Sound waves reflect off of the internal structure boundaries at varying intervals, thus creating a real-time image of the activity of the structure.

**Objective 14**

Answers should be in student's own words and should include the following:

Doppler effect is noticeable in passing vehicles, in entertainment and in any movement of sound that moves from one side of your hearing to the other. Doppler ultrasound is used to estimate blood flow or movement of other body fluids. Blood and fluids move at different speeds. This can change the frequency of the sound waves.

**Objective 15**

a. wave
b. frequency; wavelength
c. reflected; absorbed
d. photons
e. sun
f. candlepower (photometry)

**OBJECTIVE 16**

a. 2
b. 3
c. 1

**OBJECTIVE 17**

a, c, d

**OBJECTIVE 18**

a. D
b. S
c. S
d. D

**OBJECTIVE 19**

a. interaction
b. solar; nuclear
c. negatively; positively
d. stronger

**OBJECTIVE 20**

Physical effects—At least two of the following, in any order:

a. Thermal
b. Magnetic
c. Chemical
d. Radiant
e. Mechanical

Biological effects—At least two of the following, in any order:

a. Nerve stimulation
b. Therapy
c. Injury

**OBJECTIVE 21**

a. glass; plastic
b. narrow
c. fiber
d. internal tissue

**OBJECTIVE 22**

Answers should be in student's own words and should include the following:

Sheds light on the internal organ or cavity, which is inserted into the body via a tiny incision; reflects the image in magnified form back to the viewer; and provides surgeon with significant light to use specific surgical endoscopic tools

**OBJECTIVE 23**

a. IR or infrared
b. photon; color
c. waves
d. focused

**OBJECTIVE 24**

a. 3
b. 4
c. 2
d. 5
e. 1

**OBJECTIVE 25**

c, e, f, g, h

**OBJECTIVE 26**

a. linear
b. rotated
c. rotation; rotation
d. 90°
e. Helical; spiral

**OBJECTIVE 27**

a. irradiation dosages
b. radiation
c. therapeutic
d. amount or dosage
e. ingestion
f. harm
g. outside
h. ingested
i. 1 mSv; 20 mSv; justifiable benefit
j. lens of the eye

**OBJECTIVE 28**

Answers may be in any order.

a. Minimize exposure time
b. Maximize distance from source of radiation
c. Shield both the radiation source and primary or secondary irradiation recipients

## Answers to Assignment Sheets

### Assignment Sheet 1

1. a. Friction, when an object is at rest, opposes its movement. Friction, when an object is in movement, opposes the movement and tends to slow it down and eventually stop it. This is an overlooked part of gravitational force and is a key player in Newton's first law of motion. This is important in moving patients, handling equipment and knowing what to expect when performing daily tasks.

   b. An imbalanced force on an object will accelerate the object in the direction of the imbalance. Used in centrifuge, also used with each simple machine, such as levers, wedges, planes, etc. This has implications with surgical tools, etc.

   c. For every action there is a reaction, both in mass and direction. Understanding this concept will relate to the breathing of patients, use of positive and negative pressure, etc.

2. Hopefully, the students will have experienced this first hand and will be able to distinguish between moderate and high levels of separation, based on the rpms. It is possible that students will not have an opportunity to view this first hand. In that instance, see if you can supply a video or find a resource online to assist. The pull on a quickly rotating object pulls the denser blood molecules, such as proteins, to the bottom of the tube, whereas the small molecules of water are small and remain close to the top of the tube. Make sure the student mentions here that white blood cells migrate upward of the red blood cells and plasma materials are lighter, smaller or less dense than blood cells.

3. The intent of this activity is to confirm the importance of understanding gravitational force, resistance, center of gravity and proper posture and lifting techniques. This should be applied using Newton's laws of motion.

   Students' answers should include assessment of the weight of the equipment, the difficulty of access and inability to turn it around to mitigate the amount of reach and imbalance of the center of gravity.

   Law 1: The Mayo kit is extremely heavy; the friction between the surface and the object is high. Ensuring that there is a balanced force pulling at the kit will keep things from tipping. If the force is imbalanced, we must move to Law 2.

   Law 2: Moving the unit is going to require significant amounts of energy and leverage. Since there is no momentum initially, it will take significant force to move the kit, in fact, a constant acceleration from both sides. If the force is imbalanced, the kit will tip towards the direction of the imbalance and may topple. The tools within the kit assume the velocity of the kit as it is being moved, but should that velocity change, it will take longer for the tools to stop moving, and may also imbalance the kit.

   Law 3: The swing of the kit as it gains momentum based on force will incur an identical reaction, both in mass and in direction.

   Suggestions for change should include drawing the kit along the floor of the cart to where it is more immediately accessible, crouching in front of the cart instead of reaching while standing, using proper leverage to lift the kit, etc.

## Assignment Sheet 2

1. Heat moves from the warmer to the cooler object until an equilibrium is reached.

2. Conduction—The passive transfer of heat as it passes through a substance. All substances conduct heat in some fashion, though metals are certainly the best conductors.

   Convection—The movement of heat from a solid to liquids such as water or gases such as air

   Radiation—The movement of heat energy. There are a number of variables that determine whether the transfer of energy is absorbed into or adsorbed away from an object.

3. Answers should include any four of the following, with at least one being constructive and one being destructive.

   Constructive—Heat can ease muscle tension; heat can open blood vessels; heat can increase blood flow.

   Destructive—Heat can destroy tissue; heat can destroy bacteria, be used for sterilization; heat can be used to vaporize tissue; heat can cauterize.

4. Cold can also destroy tissue, but it is done through freezing water contained in the tissue. However, with supercooling, nerve sheaths remain intact, so restimulation of new growth and a speedy and complete recovery is more likely. The cold does not destroy as completely as heat does.

5. The intent here is to get the student to think not only about physical, but emotional contributors to heat gain and loss. This task involves problem solving on multiple levels.

   a. Heat gain factors: Heart activity has increased with adrenaline. Moderate exercise in both speed and stress heighten body temperature and metabolic rates. Clothing is in multiple layers. Plastic gloves, mask and eye shields reflect back body heat and increase temp. Heat loss factors: OR is cool, sweat beads have formed, heavy breathing.

   b. Potential for body that is unable to find an equilibrium to experience excessive stressors. Weakens body resistance to illness. May also lead to mental depression, disincentives to perform well.

   c. This question should be evaluated to instructor's satisfaction. Possible answers include: communication issues and things that one can control, including warm socks, creative approach to foot gear that insulate and are comfortable, that will wick moisture away from the body. To alter the situation, potential team building by calling in additional staff for help is a possibility.

6. a. An electrical path is created through the patient and burns have resulted. This tissue damage may or not be detected initially. If detected, the extent of the damage may not readily be obvious.

   b. There is no right answer here, since each case will be different. However, in most instances, it is not necessary to correct with more surgery.

c. This requires some creative thinking and answers should be evaluated to instructor's satisfaction. Some possible answers include exploring alternative equipment that may not be readily available; having a coworker double-check the ground path connections; and/or writing a request for a bipolar unit or discussing the incident with management.

**Assignment Sheet 3**

1. a. Displacement (the rock is dropped); pressure changes in the gas or liquid force a crest, then a corresponding trough; ripples continue to move through the medium. The greater the displacement, the more force the wave has and the more distance the wave travels. The effect will dissipate over time and distance. This can be converted into other forms of energy.

   b. You could enlarge the displacement by using more force, using more mass, changing the temperature of the medium, and changing the medium.

   c. Any two of the following: frequency; wavelength; tone, pitch, oscillation, resonance, harmonics, though these are secondary.

2. a. Please note that the material covered in part a. of this question isn't covered in the module; however, you may wish to have students answer this question as extra credit.

   Infrared, UV and X-rays come through the ozone layer, whereas only the strongest gamma rays even reach the earth's atmosphere and are stopped before the ozone layer. For this reason, scientists fly spacecraft high in the atmosphere to collect gamma ray data. UV rays are the most likely to have caused any damage to the skin, since Infrared is really too weak to change molecular structure, but thermally warms the skin.

   Ensure students have captured all three UV types. Mitigating factors might include any materials that inhibit wave penetration. Answers should include the transition from IR and heating of skin to UV. UVA draws out melanin, UVB can actually cause tissue damage and UVC, which is strong enough to kill germs.

   b. Rationale for moderate exposure rather than total avoidance varies, but students should be able to draw on their research and find that potential increase in the absorption of calcium and the synthesis of Vitamin D are positive side-effects of UVB.

3. Answers should include the following points in student's own words.

   Ultrasound relies on the reflections of the waves on boundaries or structures in the body. If the bones have become thin or have disintegrated, this will effect the clarity of the image, which will be much more hazy. Tumors are more dense, and therefore much more visible, so this would have the opposite effect and show up quite well.

4. TCD would be the place to start for the first child, whereas X-rays are the place to begin for the toddler.

5. Students should evaluate surgical equipment based on function and potential benefits and drawbacks. Student answers might include the following: infrared tracks the thermographic component of blood flow and can be quite powerful in spotting "hot spots" and blockages, etc. CWD provides direction, in addition to flow and velocity. This has additional benefit. X-rays can more easily spot abnormal growths and identify roots to blockages located with the previous two.

6. Any two of the following: minimize exposure time; maximize distance from source of radiation; shield both the radiation source and primary or secondary irradiation recipients.

**Assignment Sheet 4**

Answers should be evaluated to the satisfaction of the instructor.

**Assignment Sheet 5**

Answers should be evaluated to the satisfaction of the instructor.

**Assignment Sheet 6**

1. a. Students' answers should mention aseptic preparation of draping and include lead shielding for staff.

   b. Students' answers should mention lead aprons and the direction of coverage, i.e., if the staff person is facing away from the operating table, the apron should still be facing the C-arm radiation source, which means the apron would be on the back, rather than front of the person facing away.

   c. Real-time X-ray captures

2. Answers should be evaluated to the satisfaction of the instructor based on the students' visits to the health physics department of the local hospital.

3. Soft X-rays are used for diagnostics. Hard X-rays are used for therapy.

## Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 15

1. Which portion of the electromagnetic spectrum contains light waves that are slower than visible light?

   a. gamma

   b. ultraviolet

   c. infrared

   d. none of the above

Objective 24

2. Which diagnostic use for nuclear medicine alters, changes or affects the function of an organ?

   a. MRI

   b. MRS

   c. CAT

   d. SPECT

Objective 11

3. Which approach is more effective in controlling tumors?

   a. a single, massive freeze-thaw cycle

   b. freezing at temperatures at –10 C

   c. repetitive freeze-thaw cycles

   d. none of the above

Objective 21

4. Optical fiber bundles contain:

   a. fibrous particles

   b. spun plastic or glass

   c. light

   d. optical nerves

Objective 5

5. Which of the following components exemplifies a Class I Lever?

   a. surgical scissors

   b. oxygen dolly

   c. surgical knife

   d. traction

Objective 14

6. Which of the following is a location-specific Doppler unable to accurately measure high-velocity blood flow?

   a. 3D ultrasound

   b. Continuous Wave doppler

   c. Color Flow doppler

   d. Pulsed Wave doppler

Objective 28

7. Which statement most closely matches a means of external radiation protection?

   a. minimize the distance from the source of radiation

   b. shield both the source and the recipients

   c. monitor personnel for irradiation dosage

   d. secure the source in an X-ray proof container

Objective 8

8. The properties that elements and compounds possess include:

   a. conductivity, reactivity, color

   b. shape, size, color

   c. reactivity, relativity, conductivity

   d. size, relativity, shape

Objective 2

9. Which of the following is an example of normal atmospheric pressure?

   a. saliva

   b. hyperbaric pressure

   c. cerebrospinal fluid

   d. steam pressure

Objective 19

10. Electric current is ________________________________________.

   a. helpful in grounding a patient during surgery

   b. generated through osmosis

   c. the interaction of charges

   d. the movement of electrons from the negatively charged side of a conductor to the positively charged side

Objective 6

11. Which statement is an accurate description of the center of gravity?
    a. related to the distribution of force
    b. located at the point where the entire mass is concentrated
    c. remains constant, regardless of body position
    d. distributed among those body parts that are moving

Objective 21

12. Static electricity is ______________________________.
    a. a reaction
    b. a passive by-product
    c. generated by energy
    d. a flow of electric charge in a conductive material

Objective 1

13. What type of force is considered a "pull?"
    a. magnetic
    b. electrical
    c. centrifugal
    d. gravitational

Objective 27

14. Which statement does NOT match the function of the ICRP?
    a. They mandate total control of external and internal dosage.
    b. They recommend quantity of radiation exposure.
    c. They regulate occupational exposure.
    d. They regulate radiation treatment exposure.

Objective 7

15. Skeletal movement is ____________________________ in nature.
    a. translational
    b. rotational
    c. vibrational
    d. sensational

Objective 21

16. Which of the following is TRUE of fiber optics?
    a. Optical fiber is a large filament of glass.
    b. The primary use of fiber is to provide electricity.
    c. Light sent down a fiber bundle goes straight down the filament.
    d. Fiber can be used to observe surgical progress.

Objective 3

17. Which of Newton's Laws of Motion includes the force pair?

    a. First Law

    b. Second Law

    c. Third Law

    d. Fourth Law

Objective 25

18. How does tomography work?

    a. an X-ray and a detector take multiple scans to build a full picture of the object

    b. a camera performs a helical scan of the object

    c. back-projection on all three axes, using X-ray technology, surrounds the object

    d. slices are used to verify the object's function

Objective 12

19. Which variables influence frequency?

    a. distortion, pressure, temperature

    b. pressure, temperature, density

    c. temperature, distortion, harmonies

    d. density, harmonies, pressure

Objective 20

20. Which statement is most accurate?

    a. Once a magnet, always a magnet.

    b. When one electric field is brought into close proximity to another electric field, magnetic force occurs.

    c. Some magnetic fields are stronger than others, depending on their location.

    d. Magnetic north and north or south and south attract, pulling magnets together.

Objective 10

21. Which type of heat transfer is described as a passive transfer of heat as it passes through a substance?

    a. conduction

    b. convection

    c. radiation

    d. hyperthermia

Objective 5

22. The wedge is a modified version of which simple machine?

    a. lever

    b. inclined plane

    c. wheel and axle

    d. pulley

Objective 2

23. Suction is a typical example of which type of pressure?

- a. normal atmospheric pressure
- b. positive pressure
- c. negative pressure
- d. none of the above

Objective 19

24. One of the physical effects of current is ______________________________.

- a. nerve stimulation
- b. blood coagulation
- c. shock
- d. muscle movement

Objective 8

25. Which component of the atom is free-floating during ionization?

- a. electron
- b. proton
- c. neutron
- d. all of the above

Objective 27

26. The ALI (annual limit of intake) for occupational exposure is set at ________ mSv.

- a. 1
- b. 20
- c. 30
- d. 200

Objective 4

27. Which force is equivalent to the reactive force in curved motion?

- a. centrifugal
- b. circular
- c. curvilinear
- d. centripetal

Objective 15

28. Light has a dual nature. What function is light performing in having brightness and color?

- a. light as a thermal resource
- b. light as a particle of energy
- c. light as a waveform
- d. none of the above

Objective 22

29. Which surgical endoscopic tool uses high-energy current to cut tissue or coagulate blood?

    a. endocscopic scissors

    b. harmonic scalpel

    c. ligature clip appliers

    d. endoscopic electrosurgery

Objective 12

30. A change in pressure causes molecules to ___________.

    a. vibrate or collide

    b. ionize

    c. vaporize

    d. rupture

Objective 7

31. Which type of motion is a movement on the Z-axis?

    a. complex

    b. rotational

    c. translational

    d. vibrational

Objective 16

32. Which of the spectrum types is used for diagnosis and treatment?

    a. infrared

    b. X-ray

    c. ultraviolet

    d. all of the above

Objective 27

33. How long did it take after Roentgen discovered X-rays for a safety task force to emerge?

    a. 10 years

    b. 20 years

    c. 50 years

    d. 100 years

Objective 7

34. What do angular movements do?
    a. combine translational movements
    b. combine rotational movements
    c. combine vibrational movements
    d. combine skeletal movements

Objective 13

35. Which statement is most true of ultrasound scans?
    a. acquired on a two-dimensional plane
    b. measure and record absorbed sound waves
    c. translates magnetic information into sound waves
    d. acquired on a three-dimensional plane

Objective 24

36. Which lasers are often paired together in a two-tube system?
    a. Helium and Neon
    b. Nd-YAG
    c. $CO_2$ and Ruby
    d. Argon and Krypton

Objective 9

37. In which state are molecules strongly attracted to each other and very close together?
    a. solid
    b. liquid
    c. gas
    d. vapor

Objective 3

38. Which of the following exemplifies Newton's First Law of Motion?
    a. breathing
    b. popping your ears in a plane
    c. tipping an oxygen tank on a dolly
    d. pushing a patient up a ramp in a wheelchair

Objective 17

39. Choose the most accurate order, from weakest to strongest magnetic field.
    a. lung, brain, heart
    b. heart, lung, brain
    c. brain, heart, lung
    d. brain, lung, heart

Objective 11

40. What appears to be a side effect of the cryosurgery process?

    a. Destruction of the nerve sheath
    b. Permanent loss of sensation in the affected tissue
    c. Denatured protein
    d. Absence of pain

Objective 25

41. How does an MRI work?

    a. Responses to a magnetic field show areas of greater or lesser concentration to show the structure of internal organs.
    b. Exposure to a static magnetic field modifies the magnetic field of the lung, brain or heart.
    c. Records the magnetic fields generated by various parts of the body.
    d. Records brain activity in response to a stimulus.

Objective 4

42. Which particles in the hematocrit are the heaviest?

    a. plasma
    b. white blood cells
    c. nutrients, chemicals, proteins
    d. red blood cells

Objective 18

43. Which of the following is an example of radiant energy?

    a. batteries
    b. magnets
    c. geothermal energy
    d. photoelectric cells

Objective 1

44. What type of force attracts or repels?

    a. gravitational
    b. magnetic
    c. electrical
    d. centrifugal

Objective 22

45. Endoscopic surgery would not exist if it weren't for which of the following major breakthroughs?

a. video
b. heat transfer
c. laser
d. fiber optics

Objective 3

46. What force is inversely proportional to mass?

a. momentum
b. inertia
c. acceleration
d. compression

Objective 16

47. Which of the spectrum types is used for thermal diagnosis?

a. infrared
b. ultraviolet
c. X-ray
d. all of the above

Objective 5

48. Which body motion best exemplifies a Class II Lever?

a. pull-up
b. curl
c. lift
d. push-up

Objective 25

49. A CAT scan is also known as:

a. Classic Axial Thermodynamics
b. Contact Axial Thermography
c. Computed Thermography
d. Computed Axial Tomography

Objective 1

50. What type of force is considered a "push or pull?"

a. centrifugal
b. magnetic
c. electrical
d. gravitational

Objective 8

51. During ionization, the atom has a net ________ charge.

    a. neutral

    b. negative

    c. positive

    d. zero

Objective 14

52. When the source of a sound wave moves away, the wavelength ________ and the frequency __________.

    a. increases, increases

    b. decreases, decreases

    c. increases, decreases

    d. decreases, increases

Objective 9

53. When reading the ratio on a solution label, what does the first number symbolize?

    a. percentage of particles

    b. percentage of dissolving medium

    c. percentage of solution

    d. none of the above

Objective 18

54. Which of the following is an example of chemical energy?

    a. magnets

    b. geothermal energy

    c. photoelectric cells

    d. batteries

Objective 12

55. When creating waveforms, the compaction of molecules results in ____________.

    a. force

    b. equilibrium

    c. deformation

    d. friction

Objective 19

56. What do laser beams do to particles?

    a. ionize neutrons

    b. excite photons

    c. incite protons

    d. vaporize the particle nucleus

Objective 5

57. Traction is an example of which simple machine?

a. lever

b. pulley

c. inclined Plane

d. wheel and Axle

Objective 16

58. Which of the spectrum types makes use of ingested chemicals for observation of various movements?

a. infrared

b. ultraviolet

c. X-ray

d. gamma rays

Objective 6

59. Which of the following is the correct way to safely lift an object?

a. Spread your feet to shoulder width, push upward through the pelvic cavity.

b. Push upward through the pelvic cavity, crouch with one foot forward.

c. Keep the object you are lifting close to your body, raise the object to a comfortable working height.

d. Crouch with one foot forward, raise the object to a comfortable working height.

Objective 10

60. ________________ is greater in hyperthermia.

a. bodily fluid

b. respiratory constriction

c. brain activity

d. blood pressure

Objective 4

61. The hematocrit utilizes which type of force?

a. centripetal

b. centrifugal

c. circular

d. curvilinear

Objective 22

62. Which function matches the harmonic scalpel?

a. disturbs tissue proteins or causes coagulation
b. cuts tissue with retractable blades
c. uses metal clips
d. uses infrared light

Objective 13

63. Which of the following surgical procedures can ultrasounds, both 2D and 3D, be used for?

a. ablations
b. biopsies
c. drainages
d. all of the above

Objective 15

64. Light energy is measured in ____________________.

a. neutrons
b. protons
c. aeons
d. photons

Objective 8

65. The basic building blocks of an atom are ____________________.

a. molecules, electrons, photons
b. electrons, neutrons, protons
c. neutrons, molecules, protons
d. photons, neutrons, electrons

Objective 20

66. Motors use generators powered by current to produce motion. What is used in the generator to begin the process?

a. Conductors
b. Stepper motors
c. Magnets
d. Electromagnetic brushes

Objective 12

67. How is displacement in a waveform measured?
    a. in distance and time
    b. in sound and light
    c. in pressure and temperature
    d. in oscillation

Objective 9

68. What statement holds true for suspensions?
    a. generally clear
    b. generally murky
    c. homogenous throughout
    d. solid throughout

Objective 22

69. Electricity is ______________________________.
    a. the interaction of charges
    b. the movement of electrons from the negatively charged side of a conductor to the positively charged side
    c. helpful in maintaining a consistent heartbeat
    d. generated in the brain hypothalamus

Objective 23

70. Laser stands for ______________________________.
    a. Light Amplification by Stimulated Emission of Radiation
    b. Light Agitated by Simultaneous Emission of Radar
    c. Light Applied by Strength with Equal Resistance
    d. Light Amplified by Sound Emitted by Radiation

Objective 26

71. What type of CT scans are X-ray slices taken at 90° angles on a linear plane?
    a. linear
    b. back-projection
    c. helical
    d. both a and b

## Answers to Module Review

1. c
2. d
3. c
4. b
5. a
6. d
7. b
8. a
9. c
10. d
11. b
12. b
13. a
14. a
15. b
16. d
17. c
18. a
19. b
20. b
21. a
22. b
23. c
24. b
25. a
26. b
27. d
28. c
29. d
30. a
31. c
32. b
33. b
34. a
35. a
36. d
37. a
38. d
39. c
40. d
41. a
42. d
43. d
44. b
45. d
46. c
47. a
48. d
49. d
50. b
51. c
52. c
53. a
54. d
55. c
56. b
57. b
58. c
59. a
60. d
61. b
62. a
63. d
64. d
65. b
66. c
67. a
68. b
69. a
70. a
71. d

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 4-E: Robotics

# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 4-E: Robotics

## Module Contents

**COMPONENTS**

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## Suggested Activities

**INSTRUCTIONAL PLAN**

The following is a step-by-step instructional plan (preparation, delivery/application, and evaluation) to assist you in preparing for group instruction or to assist you in modifying the Learning Activities Sheet provided in the student edition for this module.

**PREPARATION**

- Review the module in the student edition carefully and plan for instruction.
- Review the "Teaching Suggestions." Plan for classroom activities.
- Develop your instructional plan. Adjust your instructional plan for different learning styles and for students with special needs.
- Prepare classroom. Put up posters and charts and display articles and other references related to this module.
- Review and obtain films, videotapes, and other resources you may want to use to supplement the instruction of this module. See "Resources Used in Developing This Module," "Suggested Supplemental Resources," and "Suggested Web Sites" for more information.
- Make transparencies from the transparency masters.
- Review Learning Activities Sheet in the student edition. Modify as appropriate to include additional activities and/or resources available in your classroom.
- Select Web sites to be inserted on the Learning Activities Sheet in the student edition.
- Prepare supplemental resources for use by your students.

**DELIVERY AND APPLICATION**

- Provide the students with the module of instruction in the student edition.
- Discuss the specific objectives on the Module Objective Sheet.
- Discuss the Information Sheet. Implement your instructional plan to localize, supplement, and personalize the objectives presented in this portion of the module. Reinforce the basic academic and workplace skills when applicable.
- Discuss the assignment sheets. Review with students the criteria for evaluation of these activities.
- Discuss and demonstrate the job sheet. Make sure all required tools, equipment, and materials are available. Review with students the criteria for evaluation of this activity and the rating scale that will be used to indicate job performance.

BEST COPY AVAILABLE

EVALUATION

- Make copies of the Written Test. Add or modify test items as needed. The Written Test serves as both a pretest and posttest to assist in measuring each student's competency gains.
- Give and evaluate pretest. Modify lesson plan to include additional instruction for those areas where students were deficient.
- Evaluate the assignment sheets. Rate the student using the criteria listed on each assignment sheet. See Answers to Assignment Sheets for correct answers where applicable. If the student's performance is unacceptable, have the student review the appropriate materials and complete the assignment again.
- Evaluate the job sheet. When the student is ready to perform a specific task, obtain a copy of the job sheet which may be found in the student edition. Then observe the student performing the procedure.

  Process evaluation—Place a mark in the box to the left of each designated checkpoint if the student has satisfactorily completed the process step(s) for each checkpoint area. If the student is unable to complete the procedure correctly, have the student review the materials and try again.

  Product evaluation—Once the student has satisfactorily completed the procedure, rate the student product (outcome) using the criteria that are provided as part of the job sheet. If the student's product is unacceptable, have the student review the materials and submit another product for evaluation.

  Two sample performance evaluation keys have been provided below. Many other keys are available. Select one rating (grading scale) that best fits your program needs.

  **Sample A**

  4—**Skilled**—Can perform job with no additional training.
  3—**Moderately skilled**—Has performed job during training program; limited additional training may be required.
  2—**Limited skill**—Has performed job during training program; additional training is required to develop skill.
  1—**Unskilled**—Is familiar with process, but is unable to perform job.
  0—**No exposure**—No information or practice provided during training program.

  **Sample B**

  **Yes**—Can perform job with no additional training.
  **No**—Is unable to perform job satisfactorily.

- Give and evaluate the posttest.
- Make copies of, give, and evaluate the Module Review.
- Compile the Written Test, assignment-sheet, job-sheet, and Module Review scores, and include any additional assignments or supplemental activities you have selected as part of your instructional plan.
- Meet individually with students to evaluate their progress through this module of instruction and indicate to them possible areas of improvement.
- Reteach and retest as required.

**TEACHING SUGGESTIONS**

- You may choose to engage students in a debate about image-enhanced surgery. Some argue that stereotactic vision or binocular vision is not all that necessary **IF** you have the proper contrast and shadows to assist in ascertaining distance, etc. This can be accomplished with proper lighting instead of dual vision. Others argue emphatically that vision enhancement and 3D modeling are an integral part of the surgical process when operating in the MIS arena. Their arguments stem from the ability for surgeons to work with digitally enhanced images that overlay the existing ones projected from the endoscope. For those who are less interested in being so dependent on computerized technology, the focus is instead on improving the endoscopic lighting, as is being done with the Endo-periscope.

- Use the article *Robotics vs. Human Golden Fingers in Gynaecological Endoscopy* as the basis for having your students argue for or against robotic assistance for laparoscopic camera control. Examine both sides of the issue, since there is room for debate. This is a chance for your students to really examine what may at first appear to be a threat and examine closely what is actually required with or without mechanical assistance. Do this in light of all three stages of the procedure. Have students list each type of robotic system available for this use. Given the conclusion reached in this article, discuss the role of the surgical technologist pre-, inter- and post-operatively. Locate the article at: www.kenes.com/cogibook1999/Robotics_Versus_Human_Golden_Fingers_in_Gynaecological_Endoscopy.html.

- Visit http://www.robot.md/publications/robodoc.pdf to obtain Joanne Pransky's article *Surgeons' Realizations of RoboDoc (Industrial Robot*, Vol. 25, No. 2, 1998, pp. 105-108.) Have students contrast the manual procedure with the robotics procedure and explain how patient data is registered. Ask students why they think RoboDoc is not as popular in the U.S.

  — Patient data explanation should include the following: pre-op CT scan; 3D identification of internal anomalies; development of bone coordinate system; implantation of 2 calibration pins in patient femur; 3D image is created for pre-planning and intra-operative use; computer-assisted selection of proper prosthetic and point of implant; surgeon approved site is recorded to the program; intra-operative interchange between surgeon and system

  — Comparison between manual and robotic results must include the following: shorter hospital stay; faster recovery; more efficient, with a decrease in cutting time

  — U.S. vs. Europe should include the following: not FDA cleared; expense; lack of public awareness or public demand; patent struggles; resistance to robotics in medicine; other rationale dependent on student

- Visit http://members.tripod.com/~Dr_Venky/sur1.html. Summarize Dr. Sastry's comments about surgical planning, the robotic procedure and safety issues in *Cybermedics: Robotic Surgery*. You may choose to have your students debate his conclusion. The following points may be included in debate:

  — Patient registration or creation of landmarks or "fiducials" can be invasive in and of itself, requiring an extra surgery vs. surface-based landmarks that do no harm, but can be quite complicated if the robotic unit is autonomous and requires sensors that will be able to detect structural anomalies instead of metal pins.

  — Precision of robotics vs. human precision depends entirely on the task and the scale of the operation. For milling bones, robotics score 83% vs. 30% for humans in obtaining fit around the prosthetic. However, 83% can be achieved by humans if a prosthetic is custom-made to fit the milled socket.

- Replacement of humans is not an option in the medical environment as it is in industry. Also, the tasks are non-generic, but patient-specific. The risk in industry is loss of resources if a fault occurs vs. the loss of life that is potentially there if robotic failure occurs during an operation.
- High costs of equipment vs. the need for specialized equipment that can do things humans can't.
- DOF of a human hand exceed those of robotics vs. precision and scale that allow those 6 DOF of a robot to do more, better.

- Visit http://www.thetech.org/exhibits_events/online/robots/overview/ to obtain more information on robotic design.
- When discussing robotic motion, have students create all three movement categories: translational, rotational, and vibrational. This can include using screws for rotational work and simple periodic motion using a spring or a pendulum. (See *Medical and Biological Engineering in the Future of Health Care*, p.28-30)
- For more information on DOF, check out additional animated clip of a robot at http://www.ite.his.se/ite/research/automation/course/gripper.htm

**RESOURCES USED IN DEVELOPING THIS MODULE**

**Books**

- Andrade, Joseph, ed. *Medical and Biological Engineering in the Future of Health Care*. Salt Lake City, UT: University of Utah Press, 1994.
- Angeles, Jorge. *Fundamentals of Robotic Mechanical Systems*. 2nd ed. Heidelberg, Germany: Springer-Verlag, 2002.
- Faraz, Ali, and Shahram Payandeh. *Engineering Approaches to Mechanical and Robotic Design for Minimally Invasive Surgeries*. Norwell, MA. Kluwer Academic Publishers, 2000.
- Greer, Chuck, and Stan Kaltwasser. *Introduction to Robotics*. Stillwater, OK. Mid-America Vocational Curriculum Consortium, 1993.
- Hunter, J.G., and J.M. Sackier. *Minimally-Invasive Surgery*. New York: McGraw-Hill, 1993.
- Jones, Daniel B., et al. ed. *Laparoscopic Surgery: Principles and Procedures*. St. Louis: Quality Medical Publishing, Inc., 1997.
- Webster, John G., ed. *Minimally Invasive Medical Technology*. Bristol, UK: Institute of Physics Publishing, Ltd., 2001.

**Journal Articles**

- Abovitz, Rony. "Digital Surgery: The Future of Medicine and Human-Robot Symbiotic Interaction." *Industrial Robot: An International Journal* 28, no. 5 (2001).
- Bernard, Chris, et al. "Robotic System for Collaborative Control in Minimally Invasive Surgery." *Industrial Robot: An International Journal* 26, no. 6 (1999).
- Broeders, Ivo A.M.J., and Jelle Ruurda. "Robotics Revolutionizing Surgery: The Intuitive Surgical "da Vinci" System." *Industrial Robot: An International Journal* 28, no. 5 (2001).
- "Clinical Testing of AESOP 3000; Surgical Robot Assists Minimally Invasive Surgery." *Industrial Robot* 25, no. 3 (1998).

- "EndoAssist Medical Robot Gains Millennium Product Status." *Industrial Robot: An International Journal* 27, no. 2 (2000).
- Hollingum, Jack. "Engineers and Surgeons Collaborate." *Industrial Robot: An International Journal* 28, no. 2 (2001).
- Leonard, Mark, and Resh Dhariwal. "Low Friction Rotating Devices Using Fluid Assisted Levitation." *Assembly Automation* 22, no. 1 (2002).
- Masani, P.R., Kybernetes. "The Scientific Methodology In the Light of Cybernetics." T*he International Journal of Systems & Cybernetics* 23, no. 4 (1994).
- Petropoulakis, Lykourgos, and Luisa Giacomini. "A Hybrid Simulation System for Manufacturing Processes." *Integrated Manufacturing Systems* 8, no. 4 (1997).
- Pransky, Joanne. "An Intelligent Operating Room of the Future—An Interview with the University of California Los Angeles Medical Center." *Industrial Robot: An International Journal* 28, no. 5 (2001).
- "Simulating Muscle Activity." *Industrial Robot: An International Journal* 27, no. 1 (2000).
- Townsend, William T., and Jeffrey A. Guertin. "Teleoperator Slave—WAM Design Methodology." *Industrial Robot: An International Journal* 26, no. 3 (1999).
- Wright, James. "Technology requirements for robotic surgery." *Industrial Robot: An International Journal* 28, no. 5 (2001).

**SUGGESTED WEB SITES***

**Medical Robotics Manufacturing**

- www.urs-group.com
- www.microdexsys.com
- www.computermotion.com
- www.mdx.ac.uk/www/ammc/apd
- http://nctn.hq.nasa.gov/innovation/Innovation52/robsurg.html
- http://www.intuitivesurgical.com
- http://www.integratedsurgical.com/
- http://www.armstrong-healthcare.com/endoassist.htm
- www.robodoc.com
- www.intuitivesurgical.com/products
- www.sri.com/ipet/ts.html
- www.pentax-endoscopy.com

**Medical Robotics Educational Programs**

- http://robotics.technion.ac.il
- http://www-sop.inria.fr/chir/research/planning.html

- www.clevelandclinic.org/neurosurgery/research/camisresearch
- www.ri.cmu.edu/labs
- http://biorobotics.harvard.edu
- www.upmc.edu/minsurg
- www.meddean.luc.edu/lumen/deptwebs/surgery
- www.robotic.dlr.de/medical
- http://robotics.eecs.berkeley.edu/~mcenk/medical/
- www.ius.cs.cmu.edu/afs/cs/project/mrcas
- www.ntu.edu.sg/mpe/research/groups/mrcas
- www.seas.upenn.edu/~meam520/robot_links/medical.html
- http://robotics.me.jhu.edu
- http://robotics.stanford.edu
- www.mdphd.pitt.edu

**Robotics Publications**

- www.ncbi.nlm.nih.gov

  This is the National Library of Medicine's Web site.

- www.foresight.org/nanomedicine/surgery.html

  This Web site contains listings for surgical robotics publications.

- http://www9.medica.de/cipp/md_medica/custom/pub/content,lang,2/ticket,g_a_s_t/oid,5228

  This is the Medica Information Portal.

- www.pubmed.ca

  This Web site contains PubMed listings.

- www.hsforum.com/robotics

  The Heart Surgery Forum is an excellent resource.

- www.mrcas.ri.cmu.edu/links/geo.html

  This Web site contains robotics research links.

*Web-site addresses were accurate and all content on referenced Web sites was appropriate during development and production of this product. However, Web sites sometimes change; MAVCC takes no responsibility for a site's content. The inclusion of a Web site does not constitute an endorsement of that site's other pages, products, or owners. You are encouraged to verify all Web sites prior to use.

## Written Test

Name ____________________

Date ____________________ Score ____________________

**Objective 1** Complete the following statements concerning the trend towards minimally invasive surgery Write your answers on the blank lines provided in the statements below.

a. Minimizes ____________________ and negative effects on patient

b. ____________________ desired results related to surgery

c. Increases speed of ____________________

d. Reduces ____________________

e. Increases ____________________ of hospital staff

f. ____________________ long-term expense of surgery

**Objective 2** List the four drawbacks of minimally invasive surgery.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

**Objective 3** Complete the following statements concerning surgical categories more easily adapted to MIS techniques. Write your answers on the blank lines provided in the statements below.

a. __________ and __________ procedures are more easily adapted to MIS techniques and robotic procedures.

b. Reconstructive procedures involve the __________ or __________ of structures.

c. Ablative procedures involve __________ or __________ of tissue.

d. __________ volume procedures are more often considered for expensive equipment, since they provide a faster means of recouping costs.

e. Congenital defect surgery is an example of a __________ volume procedure.

**OBJECTIVE 4** List four of the fundamental impacts digital information has had on MIS technologies.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

**OBJECTIVE 5** List three conditions which make the use of a robot instead of a human attractive.

a. ______________________________

b. ______________________________

c. ______________________________

**OBJECTIVE 6** Match the robotic characteristics that promote their use in surgical procedures on the right to their correct descriptions.

______ a. Responsive to surgeon's direction in performing routine tasks

______ b. Ability for less invasive, more accurate procedures, minimizing patient risk

______ c. Sizing of tools down to microscopic levels

______ d. Ability to perform without illness or loss of concentration, early or late without tiring

______ e. Response to surgeon's movement by a greater than 10:1 ratio

______ f. Ability to perform task again and again with precision

______ g. Ability to limit movement to microns

1. Efficiency
2. Miniaturization
3. Patient safety
4. Precision
5. Reliability
6. Repeatability
7. Scaling

**OBJECTIVE 7** Arrange in order the seven steps for integrating robotics into surgical procedures by writing a "1" next to the first step, a "2" next to the second step, and so on.

_____ a. Perform surgery, either directly on the patient or from a distance

_____ b. Build computer-aided 3D anatomical models

_____ c. Match registration to patient position

_____ d. Scan to acquire patient-specific anatomical data

_____ e. Separate into specific organs, structures and tissues

_____ f. Establish image-guided tracking of surgical instruments relative to landmarks, tissue and organs

_____ g. Perform model registration, either by external pins or by internal uniquenesses that will provide surgical guidance and navigation

**OBJECTIVE 8** Describe four of the benefits of using robotics in MIS.

a. ________________________________________

b. ________________________________________

c. ________________________________________

d. ________________________________________

**OBJECTIVE 9** Identify three types of surgery where robotics can play a significant role.

a. ________________________________________

b. ________________________________________

c. ________________________________________

**OBJECTIVE 10** List two pre-operative benefits of using robotics.

a. ________________________________________

b. ________________________________________

**OBJECTIVE 11** Complete the following statements concerning the inter-operative benefits of using robotics. Write your answers on the blank lines provided in the statements below.

a. Precision

- Miniaturization is smaller than human hands and more ______________.
- Movements can be set to ________ instead of inches.
- ___________ can be established and controlled exactly.
- __________ of tremor
- Uses of ____________ marks to act on a much finer scale than humans can

b. Access and dexterity

- Gauges minute changes in pressure, resistance through _________
- Manages ___________ deflections
- Provides less damaging or less invasive access
- Offers new opportunities to access _______ and ________ not possible without robotics or with greater potential of death

c. ___________ visual images by robotic camera vis-à-vis hand-held

**OBJECTIVE 12** Select true statements concerning post-operative benefits of using robotics by placing an "X" in the blanks next to the true statements.

_____ a. Improved data manipulation

_____ b. Reduced complications

_____ c. Review of surgery

_____ d. Patient feedback

_____ d. Monitoring patient

**OBJECTIVE 13**

Complete the following statements contrasting open incisions and MIS incisions. Write your answers on the blank lines provided in the statements below.

a. Typical diagnostic keyhole incisions are __________ in length.

b. Typical therapeutic keyhole incisions are __________ in length.

c. The typical number of keyhole incisions varies between ______ and _____.

d. Typical open surgery incisions are __________ in length.

e. The typical number of open incisions varies between _____ and ______.

**OBJECTIVE 14**

Complete the following statements concerning key events in the invention of medical scope technology. Write your answers on the blank lines provided in the statements below.

a. Introduction of the ____________________ which increased light and thus heightened visibility by over _______ times

b. Development of ________________ by a gastroenterologist

c. ________________ visualization of the area

d. Angled lens ________________ for multiple viewing angles

**OBJECTIVE 15**

Match the two key scope types developed for endoscopic surgery since its advent in the late 1970's on the right to their correct descriptions.

_______ a. Tubing, normally of silicone-plastic, that shapes to various body contours to allow for multiple viewing angles

_______ b. A narrow, metal hollow tube used for viewing internal structures in the forward direction

1. Flexible scopes
2. Rigid scopes

**OBJECTIVE 16**

Select true statements concerning the difference in surgical stance when using flexible vs. rigid extenders by placing an "X" in the blanks next to the true statements.

_____ a. When using rigid stem graspers, the surgeon's elbows are free to drop to a comfortable level.

_____ b. When using flexible stem graspers, the surgeon's elbows remain about level with pectoral muscles in the chest.

_____ c. When using rigid stem graspers, tension from shoulders to elbows can produce rapid fatigue and tremor.

_____ d. Using flexible stem graspers reduces fatigue.

**OBJECTIVE 17** List six primary issues in minimally invasive surgery.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

**OBJECTIVE 18** Compare surgical technique in MIS with and without robotics by completing the table below.

| Surgical approach | Camera control | Landmarks | Surgical stance |
|---|---|---|---|
| Typical endoscopic surgery | | | |
| Robotics | | | |

**OBJECTIVE 19** Describe the uses of the four basic types of surgical robots.

a. Computer-aided supervisory robots or dexterity-enhancing robots—____________________

b. Image-guided robots—____________________

c. Tele-operative robots—____________________

d. Autonomous robots—____________________

**OBJECTIVE 20** Describe latency and its impact on telesurgery.

a. Latency—

b. Impact of latency on telesurgery—

**OBJECTIVE 21** List the primary serial robotic components.

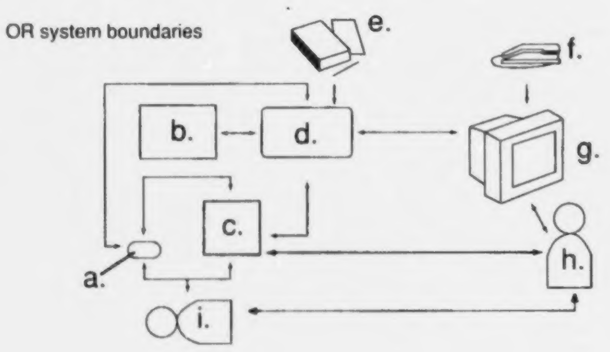
a.

b.

c.

d.

**OBJECTIVE 22** Identify each of the components in a telesurgical interaction.



a.

b.

c.

d.

e.

f.

g.

h.

i.

**OBJECTIVE 23** Describe the functions of sensors and actuators.

a. Sensors— ______________________________

______________________________

b. Actuators— ______________________________

______________________________

**OBJECTIVE 24** Match sensor types to their correct descriptions. Write the corresponding numbers on the blanks provided.

| | | |
|---|---|---|
| ______ | a. Register temperature of surrounding area | 1. Proximity sensors |
| ______ | b. Determine how close the tool is to the desired destination | 2. Tactile sensors |
| ______ | c. Enhance and increase the sense of touch | 3. Thermal sensors |
| ______ | d. Interpret images and relay these to the controller | 4. Visual sensors. |

**OBJECTIVE 25** Describe the robotic components of the articulated mechanical system (AMS).

a. Links— ______________________________

______________________________

b. Joints— ______________________________

______________________________

c. End effector— ______________________________

______________________________

**OBJECTIVE 26** Complete the following statements concerning what drives robotic arms by circling the correct words.

a. Belt-driven arms are an example of the **(mechanical, electrical)** method of robotic movement.

b. Pulleys and gears are **(mechanical, electrical)** devices that can be used to drive robotic arms.

c. Robotic arms can be moved through **(electrical, mechanical)** means when connected to servo motors.

**OBJECTIVE 27** Describe the sequence of events leading to robotic manipulation.

a. Positioning— ______________________________

______________________________

b. Orienting— ______________________________

______________________________

c. Manipulating objects— ____________________________________________

____________________________________________

**Objective 28** List the basic types of movement.

a. ____________________________________________

b. ____________________________________________

c. ____________________________________________

d. ____________________________________________

**Objective 29** Define *yaw*, *pitch*, and *roll*.

a. Yaw ____________________________________________

b. Pitch____________________________________________

c. Roll ____________________________________________

**Objective 30** Match each degree of freedom in the human arm to its motion. Write the corresponding numbers on the blanks provided.

✔ **NOTE:** Motions will be used more than once.

| | | | |
|---|---|---|---|
| _______ | a. Pivot shoulder up/down | 1. | Pitch |
| _______ | b. Pivot shoulder left/right | 2. | Roll |
| _______ | c. Rotate shoulder | 3. | Yaw |
| _______ | d. Pivot elbow up/down | | |
| _______ | e. Pivot wrist up/down | | |
| _______ | f. Pivot wrist left/right | | |
| _______ | g. Rotate wrist | | |

**Objective 31** Complete the following statements comparing the degrees of freedom in a rigid endoscope and a flexible endoscope. Write your answers on the blank lines provided in the statements below.

a. Basic rigid (fixed) endoscopes have _____________ DOF.

b. Flexible endoscopes can have between ________ and ________ DOF.

**OBJECTIVE 32**

Complete the following statements concerning the degrees of freedom in a jointed robotic arm. Write your answers on the blank lines provided in the statements below.

a. Rotate __________—Roll

b. Pivot shoulder—__________

c. Pivot __________—Pitch

d. Pivot __________ up/down—Pitch

e. Pivot wrist left/right—__________

f. Rotate __________—Roll

**OBJECTIVE 33**

Complete the following statements concerning the four possible robotic control modes by circling the correct words.

a. The **(manual, collaborative, shared, autonomous)** control mode allows deviation from a specified path only on one axis, while the robot maintains control of the other axis.

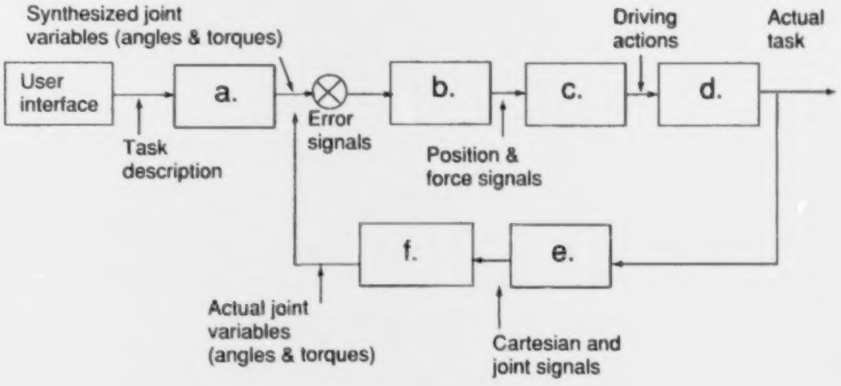
b. The **(manual, collaborative, shared, autonomous)** control mode allows for total override of the robotic system and also allows the robotic system to function autonomously for another segment.

c. The surgeon specifies a beginning and end point and the robotic system computes the course of action and performs the task. This is an example of the **(manual, collaborative, shared, autonomous)** control mode.

d. The **(manual, collaborative, shared, autonomous)** mode allows the surgeon to set up and program specific segments of the procedure.

**OBJECTIVE 34**

Identify the components of robotic control.


Synthesized joint variables (angles & torques)
User interface
a.
Task description
Error signals
b.
Position & force signals
c.
Driving actions
d.
Actual task
f.
e.
Actual joint variables (angles & torques)
Cartesian and joint signals

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

**OBJECTIVE 35** List two options available for the user interface control and two options for monitoring the surgical process.

a. User interface

- ____________________
- ____________________

b. Visualization system

- ____________________
- ____________________

**OBJECTIVE 36** List four possible sensate options that should be available for the optimal haptics interface design.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

**OBJECTIVE 37** Select true statements concerning the use of landmarks with robotics by placing an "X" in the blanks next to the true statements.

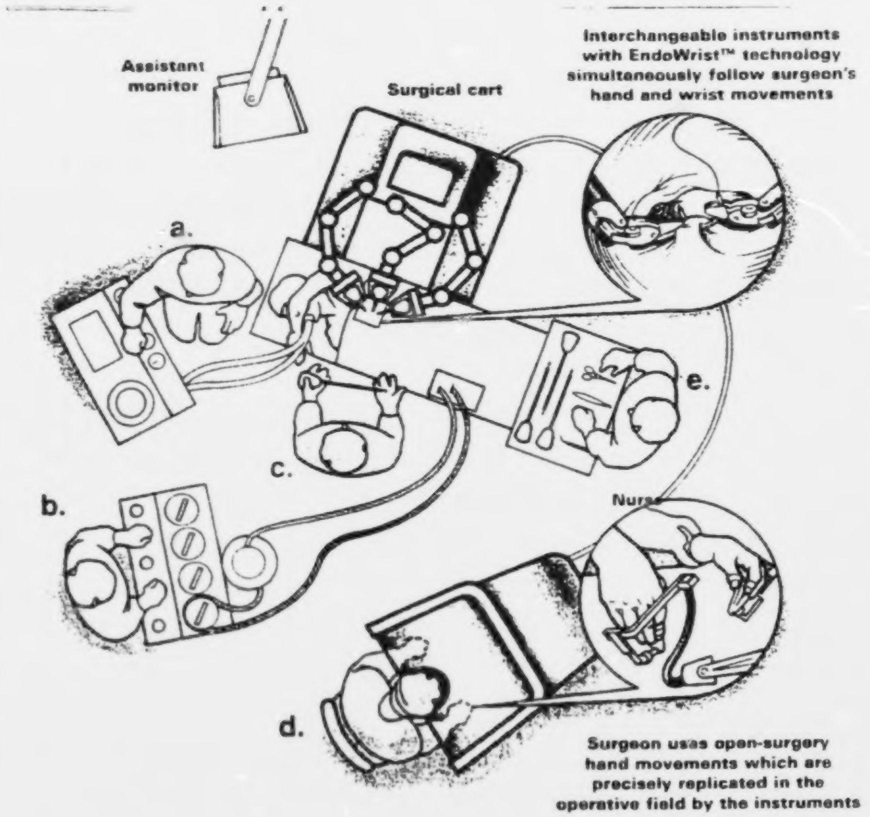
Frames of reference or landmarks serve to:

_____ a. designate robotic movement by generic marks true to most patients.

_____ b. specify relationships between landmarks and structures.

_____ c. assist in circumnavigation.

**OBJECTIVE 38** Identify each of the primary players during surgery by labeling the diagram below.



Interchangeable instruments with EndoWrist™ technology simultaneously follow surgeon's hand and wrist movements

Surgeon uses open-surgery hand movements which are precisely replicated in the operative field by the instruments

a. ______________________ b. ______________________

c. ______________________ d. ______________________

e. ______________________

**OBJECTIVE 39** List the four basic imaging tools used during an MIS procedure.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

**OBJECTIVE 40** List six surgical tools potentially used during an MIS procedure.

a. ______________________

b. ______________________

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c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

**OBJECTIVE 41**

Arrange in order the four basic preparatory steps for MIS or robotic procedures by placing a "1" next to the first step, a "2" next to the second step, and so on.

_____ a. Position patient.

_____ b. Position equipment

_____ c. Drape equipment

_____ d. Position and set up operating table

**OBJECTIVE 42**

Arrange in order the steps to properly prepare and position robotic systems by placing a "1" next to the first step, a "2" next to the second step, and so on.

Prior to establishing sterile field:

_____ a. Collect and check robotic tray.

_____ b. Position systems.

_____ c. Collect and check surgical console.

_____ d. Move cart carrying robotics to OR table.

_____ e. Collect and check video tower.

_____ f. Collect, check and connect robotic arm(s).

_____ g. Position robotic arm(s).

After establishing sterile field:

_____ h. Attach sterile instruments.

_____ i. Drape robotic arm(s) and hand control using aseptic technique and cinching them tight with provided tape.

_____ j. Attach instrument collars from sterilization tray.

**OBJECTIVE 43**

Complete the following statements concerning issues that must be addressed before integrating robotics into the OR. Write your answers on the blank lines provided in the statements below.

a. Clear the ________________. Too many cables and too much equipment makes for difficult logistics. Ceiling mount or get into special room as much of equipment as possible, so that the OR is clear.

b. ________________ times need to be shortened. Some of this is accomplished by becoming used to new procedures, but some requires a rethink of draping and sterilization techniques and sheer volume of equipment.

c. Equipment __________________ should mandate a different approach to monitor setup, table placement, etc.

d. An OR _____________________________ is a dedicated space for robotic and videoscopic surgery.

*Permission to duplicate this test is granted.

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## Answers to Written Test

**OBJECTIVE 1**

a. surgical stressors
b. maximizes
c. recovery
d. complications
e. productivity
f. reduces

**OBJECTIVE 2**

Answers may appear in any order.

a. May be more expensive and less effective, depending on the surgery
b. Loss of surgical freedom of movement
c. First-hand view of tissues is unavailable
d. Reliance on expensive equipment

**OBJECTIVE 3**

a. Excisional; ablative
b. joining; connecting
c. removal; destruction
d. High
e. low

**OBJECTIVE 4**

Any four of the following. Answers may appear in any order.

a. Digital data collection
b. Digital manipulation
c. Simulation
d. Real-time relay of information
e. Micro-dexterity
f. Scaling
g. Teleconnections

**OBJECTIVE 5**

Any three of the following. Answers may appear in any order.

a. Inhospitable or hazardous environments
b. Minimal access; remote or microscopic environments
c. Extremely demanding tasks that may incur high levels of fatigue
d. Reduction of patient risk and enhancement of surgical precision

**OBJECTIVE 6**

a. 1
b. 3
c. 2
d. 5
e. 7
f. 6
g. 4

**OBJECTIVE 7**

a. 7
b. 3
c. 5
d. 1
e. 2
f. 6
g. 4

**OBJECTIVE 8**

Any four of the following. Answers may appear in any order.

a. Converts open surgeries to MIS
b. Increases precision
c. Improves dexterity
d. Allows for telesurgery
e. Provides opportunity for virtual surgery
f. Creates a telementoring environment

**OBJECTIVE 9**

Any three of the following. Answers may appear in any order.

a. Optical surgery
b. Neurosurgery
c. Ear, nose and throat surgery
d. Cardiac surgery
e. Orthopedic surgery
f. Endoscopic surgery
g. Radiosurgery

**OBJECTIVE 10**

Answers may appear in any order.

a. Data collection.
b. Interactive planning, feedback
c. Potential "dry-run" via simulation of both rigid and deformable entities

**OBJECTIVE 11**

a.
- accurate
- microns
- Speed
- Lack
- registration

b.
- sensors
- tissue
- head; neck

c. Steady

**OBJECTIVE 12**

b, c, e

**OBJECTIVE 13**

a. 2–10 mm
b. 5–30 mm
c. 2; 5
d. 10–40 cm
e. 1; 3

**OBJECTIVE 14**

a. rod lens setup; 80
b. fiber optic cable
c. Direct
d. laparoscope

**OBJECTIVE 15**

a. 1
b. 2

**Objective 16** b, d

**Objective 17** Answers should any six of the following:

a. Restricted access
b. Additional momentum
c. Restriction of movement
d. Restricted or absent sensorial feedback
e. Awkward surgical stances
f. Potential for "sword fighting" of extenders, based on placement or positioning
g. Potential for puncture of blood vessels
h. Potential for injury to tissue
i. Potential for nerve damage
j. Potential for thermal injuries

**Objective 18**

| Surgical approach | Camera control | Landmarks | Surgical stance |
|---|---|---|---|
| Typical endoscopic surgery | *Hand-held* | *Minimal landmarks* | *Standing, often with arms tensed* |
| Robotics | *Guided* | *Registration, established landmarks* | *Telesurgical stance where surgeon is often seated at a console* |

**Objective 19** Answers should include the following in student's own words:

a. Used in the surgical suite to assist in navigation, enhance surgical accuracy or increase dexterity; used to perform microsurgical tasks impossible to achieve by human hands alone
b. Used in the surgical suite to relay MIS internal information that is not readily visible as it would be during open surgery
c. Used in the surgical suite via remote control, which can be in the same room or across an ocean
d. Perform specific tasks without human intervention

**Objective 20** Answers should include the following in student's own words:

a. The delay as information is translated from surgeon to robot to patient tissue and then translated from patient tissue to robot to surgeon
b. The speed of this translation is critical in making use of robotics. When there is significant delay (latency), it makes usage of the mechanism much less useful and more awkward.

**Objective 21**

a. Power source
b. Operating console, user interface
c. Program and controller
d. Articulated mechanical system (AMS)

**OBJECTIVE 22**

a. Encoders and sensors
b. Actuators
c. Robot
d. Computer program
e. Pre-op scans
f. Remote surgeon
g. Computer interface
h. Surgeon
i. Patient

**OBJECTIVE 23**

a. Send signals about the state of the system and the operating field back to the controller
b. Drive hardware that performs the requested task(s)

**OBJECTIVE 24**

a. 3
b. 1
c. 2
d. 4

**OBJECTIVE 25**

Answers should include the following in student's own words:

a. Single arm, with joints at one or both ends.; multiple arms
b. Each degree of freedom in the joint requires a sensor to measure its action; prismatic axis and rotary axis
c. Each degree of freedom in the end-effector requires a sensor to measure its action; consists of point (stylus, idealized finger), two-point (two fingertips for pinch grip), and instrument attachment

**OBJECTIVE 26**

a. Mechanical
b. Mechanical
c. Electrical

**OBJECTIVE 27**

a. Used to get the robotic arm to a specific point in space
b. Used to turn or move the end-effector or tool so that it is prepared and properly aligned to perform a specific task
c. Once the robot is positioned and oriented, the end-effector or tool can grasp, move, lift, turn a given object or perform its specified task.

**OBJECTIVE 28**

Answers may appear in any order.

a. Up and down
b. Left and right
c. In and out
d. Open and closed

**OBJECTIVE 29**

a. Yaw—Rotational and prismatic motion that moves left to right
b. Pitch—Rotational and prismatic motion that moves up or down
c. Roll—Rotational motion

**OBJECTIVE 30**

a. 1
b. 3
c. 2
d. 1
e. 1
f. 3
g. 2

**OBJECTIVE 31**

1. 4
2. 5; 6

**OBJECTIVE 32**

a. waist or shoulder
b. Yaw
c. elbow up/down
d. wrist
e. Yaw
f. wrist

**OBJECTIVE 33**

a. shared
b. collaborative
c. autonomous
d. manual

**OBJECTIVE 34**

a. Image processor
b. Control processor
c. Actuators
d. Robot
e. Sensors
f. Information processor

**OBJECTIVE 35**

a. Answers should include any two of the following:
   - Joystick, keyboard, mouse
   - Eye or head movement control systems
   - Haptic interface, usually teleoperated

b. Answers should include any two of the following:
   - 3D—Either head-mounted gear or a remote monitor (telemanipulation)
   - 2D

**OBJECTIVE 36**

Answers should include any four of the following:

a. Force
b. Pressure
c. Resistance
d. Shearing
e. Weight
f. Torque
g. Texture
h. Temperature
i. Vibration

**OBJECTIVE 37**

b

**OBJECTIVE 38**

a. Anesthesiologist
b. Heart and lung specialist
c. Assistant
d. Surgeon at operative console
e. Surgical technologist

**OBJECTIVE 39** Answers may be in any order:

a. Endoscope
b. Light source
c. Camera or video system
d. High Resolution monitor

**OBJECTIVE 40** Answers should include any six of the following, in any order:

a. Coagulator
c. Dissection tools
c. Electrocautery tools
d. Extenders
e. Harmonic scalpel
f. Holding or moving tools
g. Irrigation and aspiration tools
h. Insufflation tools
i. Laparoscopic ultrasound wand
j. Laser tools for cautery, coagulation, and vaporization
k. Ligation tools
l. Retraction tools
m. Suturing and knot tying tools
n. Stapling or clipping tools

**OBJECTIVE 41**

a. 4
b. 1
c. 3
d. 2

**OBJECTIVE 42**

a. 3
b. 5
c. 1
d. 6
e. 2
f. 4
g. 7
h. 10
i. 8
j. 9

**OBJECTIVE 43**

a. space
b. Set up
c. ergonomics
d. specialized room

## Answers to Assignment Sheets

**Assignment Sheet 1**

1. Answers should include references to minimizing surgical stressors and negative effects on patient; maximizing desired results related to surgery; increasing speed of recovery; reducing complications; increasing productivity of hospital staff; reducing long-term expense of surgery; allowing for miniaturization; increasing precision; increasing dexterity, etc. Personal experiences in the health industry, if any, must relate to this trend.

2. The student must have selected one of the four drawbacks listed in Objective 2. Focus on more expense for equipment and less effective surgery, depending on the procedure should include examples of procedures that ARE less expensive when performed as open surgery that also do not impact long-term recovery. Loss of surgical freedom of movement should focus on DOF inside the body vs. DOF in open surgery. DOF internally is generically very limited (sometimes only 4 DOF) whereas open surgery allows for as many as 24 DOF, depending on surgical manipulation. Viewing difficulties must include endoscopic limitations and difficulty with surgical perspective. Reliance on expensive equipment arguments should focus on overall hospital costs, limiting of resources, greatest good vs. specialization, etc.

   Be sure that the student has applied their arguments to a specific situation or given a concrete example for their rationale.

3. Surgical procedures fall into various levels of complexity and frequency or volume of procedure. It has been shown that in some instances, open surgery is less expensive and just as effective if you do not calculate in the recovery time. However, if factoring in recovery time, it is hands-down a laparoscopic procedure. Time in surgery is most often equivalent, and expense is lower for the patient if it is performed laparoscopically.

**Assignment Sheet 2**

**Part I**

1. Computer-aided supervisory robots or dexterity enhancing robotics: Endo-assist, RoboDoc, Zeus, da Vinci, SRI, Caspar, Artemis

2. Image-guided robots: Neuromate, Zeus, da Vinci, SRI, Artemis

3. Tele-operative robotics: Neuromate, Zeus, da Vinci, SRI, Artemis

4. Autonomous robotics: Neuromate, APD (non-surgical)

**Part II**—Students should choose to answer two of the situations.

Situation 1 Neurosurgical procedures are benefiting from robotics more than some other areas, since there are access issues that robotics can assist to resolve that are not really an option otherwise. To that end, having a simple robotic camera assistant can help if the brain tumor is accessible through standard MIS procedures, but robotic arms would be required when this is not the case.

Situation 2 Zeus, da Vinci, ARTEMIS are possible robotic candidates. Strongest candidate could be any one of them. Be sure the information that students cover comes from the Web site and is not manufactured!

Situation 3 Student must cover external landmark registration using pins or magnets, and internal registration based on anomalies. Students should be able to describe patient prep just as they would prior to surgery.

**Assignment Sheet 3**

**Part I**—Diagram should include the following components: base, shoulder, elbow, wrist, and end-effector.

**Part II**—Action and alternative should include the following:

a. Verify sensor is not obscured with blood or tissue.

b. Check for backup sensors on unit.

c. Reboot system (depends on timing: how critical is the surgery and the timing?).

d. Replace sensor (depends on timing: how critical is the surgery and the timing?).

e. Replace robot (not very sensible, given the expense).

**Part III**—Robot positioning is related to moving the arm to a specific location as the first step in three for actually performing a task. Robot orienting is performed by the wrist in turning the end effector so that the tool or instrument it holds is aligned to perform the task as the second step in three for performing a task.

**Assignment Sheet 4**

a. Yaw

b. Roll

c. Pitch

d. Pitch

e. Yaw

f. Roll

g. Roll 1

h. Pitch/Yaw

i. Roll 2

## Assignment Sheet 5

| | |
|---|---|
| Situation 1 | Most surgeons will argue that regardless of malfunction, there is no room to handle faults real-time. Instead, the preference is to back out and begin the manual procedure without the robot. |
| Situation 2 | Any option is possible. The option most likely to succeed is actually the stereotactic frame with Cartesian robot (PPP) but this is only one method. The critical component in this exercise is to explain each of the X, Y and Z translational or prismatic movements and possibly reference to the graphic from TPC. If the cousin is emphatically opposed to robotics, it may be for the following reasons: frameless surgery is still in its infancy and is not yet able to provide precise landmarks and real-time data about instrument position; lack of landmarks and need for real-time registration with sufficient contrast; use of volumetric stereotaxis will resolve some rather significant issues, assisting in a more complete tumor removal and minimizing normal brain tissue damage. |

## Module Review

Name ______________________________

Date ____________________ Score ____________________

**DIRECTIONS** Read each of the items below. From the choices given, select the response that most correctly provides the required information. Circle the letter of the most-correct response.

Objective 10

1. Which of the following is a benefit of pre-operative procedures?

   a. anatomical modeling

   b. registration

   c. surgical review

   d. scaling

Objective 3

2. Excisional procedures involve ____________________.

   a. removal of a structure

   b. review of a structure

   c. diagnosis of a structure

   d. ablation of a structure

Objective 14

3. Which of the following best describes the function of fiber optic cables?

   a. a cable that carries light

   b. a cable made of glass or plastic fiber

   c. a cable that carries laser light, encoded with digital signals, and made of thin fibers of glass or plastic

   d. a cable designed to optically enhance surgery

Objective 42

4. Which of the following components would NOT be included in the robotic tray or cart?

   a. system control unit

   b. foot pedals

   c. system drapes

   d. sterilization tray

Objective 1

5. The most accurate definition of minimally invasive surgery involves which of the following?
    a. using an incision smaller than 10 cm to perform surgery
    b. using three or more small incisions to perform surgery
    c. replacing open surgery with an approach that requires the use of an endoscope and several surgical tools that allow the surgeon to operate with less significant impact
    d. requiring surgeons to perform minimal procedures to maximize results

Objective 25

6. Which of the following is NOT part of an end effector?
    a. wrist
    b. fingers
    c. grip
    d. instrument attachment

Objective 29

7. Rotational and prismatic motion that moves up and down is called ____________.
    a. yaw
    b. pitch
    c. roll
    d. pivot

Objective 9

8. Which of the following three types of surgery can robotics play a significant role?
    a. orthopedic, gastrothoracic, and radiosurgeries
    b. genitourinary, obstetric, and cardiovascular surgeries
    c. gynecological, orthopedic, and plastic surgeries
    d. optical, cardiac, and neurosurgeries

Objective 1

9. The trend towards minimally invasive surgery revolves around which of the following?
    a. minimizing surgical impact and maximizing surgical results, while speeding rate of recovery and reducing patient pain
    b. keeping the cost of surgery to a minimum
    c. updating surgical procedures to the latest conclusions of researchers and scientists
    d. attempting to create the proper environment for surgical professionalism

Objective 15

10. Rigid scope tubes are generally made of _________ and flexible scope tubes are normally made of __________.

  a. metal, rubber

  b. brass, black plastic

  c. molybdenum, silicone plastic

  d. metal, silicone plastic

Objective 8

11. Training and preparation for surgery without actually performing the procedure is known as ____________________.

  a. telesurgery

  b. telepresence

  c. virtual surgery

  d. telementoring

Objective 1

12. Several of the goals of MIS include __________ staff productivity and enhancing the speed of __________________.

  a. increasing, the procedure

  b. increasing, recovery

  c. minimizing, results

  d. maximizing, surgery

Objective 43

13. One of the greatest challenges for the surgical technologist is in managing change. Which of the following changes is the surgical technologist least likely to strongly influence?

  a. equipment ergonomics, including monitors and table placement

  b. organization of space, including cables and volume of equipment

  c. specialized OR rooms to accommodate new equipment

  d. shortened prep time by approach to procedure and aseptic technique

Objective 11

14. The precision of robotic movements is measured in _______ not __________.

  a. English, metric

  b. inches, microns

  c. microns, inches

  d. millimeters, centimeters

Objective 2

15. Minimally invasive surgery ______________________________.

    a. does not allow the surgeon direct access to patient structures
    b. enhances surgical freedom of movement
    c. relies on readily available equipment
    d. is more effective and less expensive

Objective 12

16. What is the typical recovery time frame for open procedures?

    a. 2 weeks
    b. 4 weeks
    c. 6 weeks
    d. 8 weeks

Objective 12

17. Specialists and the surgeon can review the entire procedure by examining the images captured during the event. Which of the following most closely matches this benefit?

    a. post-operative surgical review
    b. pre-operative surgical review
    c. inter-operative surgical review
    d. none of the above

Objective 11

18. Miniaturization, controlled speed, lack of tremor and use of registration marks are part of which primary robotic inter-operative benefit?

    a. precision
    b. simulation
    c. dexterity
    d. access

Objective 2

19. MIS may be more __________ and less __________ than open surgery.

    a. preventive, invasive
    b. comprehensive, drastic
    c. progressive, conservative
    d. expensive, effective

Objective 10

20. Which is NOT an example of pre-operative imaging?

    a. C-arm

    b. MRI

    c. ultrasound

    d. CT scans

Objective 3

21. Which MIS procedure is the least complex and most frequently performed?

    a. Nissen Fundoplication

    b. gastric bypass surgery

    c. colectomy

    d. cholecystectomy

Objective 38

22. In the da Vinci diagram, the surgeon is located ____________________.

    a. at the operative console

    b. across from the assistant

    c. across from the surgical robot

    d. in another room

Objective 28

23. Which of the following is a function of the X-axis?

    a. open, close

    b. up, down

    c. left, right

    d. in, out

Objective 19

24. The hallmark of image-guided robotics is ____________________.

    a. microsurgical precision

    b. remote control of the robot

    c. the relaying of internal structural information during MIS

    d. all of the above

Objective 2

25. The primary drawbacks to MIS are inaccessibility and no ______________ of tissue.

    a. abrasion
    b. first-hand view
    c. ablation
    d. first-hand pressure

Objective 18

26. What is the greatest drawback to the typical laparoscopic procedure?

    a. strain and fatigue
    b. little option for identifying tool types
    c. extensive use of anesthesia
    d. none of the above

Objective 23

27. The function of ___________ is to send signals about the state of the system and the operating field back to the controller.

    a. actuators
    b. links
    c. sensors
    d. end-effector

Objective 14

28. What event was fundamental to the proliferation of laparoscopic surgeries?

    a. the introduction of the rod lens and fiber optic cable
    b. the introduction of silicon and viewing angles
    c. the invention of angled cables by a gastroenterologist
    d. the mass production of miniature cameras

Objective 3

29. Ablative procedures involve ______________________________.

    a. removal of tissue
    b. review of tissue
    c. removal or destruction of tissue
    d. excision of tissue

Objective 31

30. How many degrees of freedom are in a flexible endoscope?

    a. 3–4

    b. 4–5

    c. 5–6

    d. 7–8

Objective 22

31. Remote surgeon(s) that participate in a telesurgical procedure do so by connecting to the ________________________.

    a. actuators and activators

    b. robotic arm

    c. local surgeon

    d. computer interface

Objective 3

32. Reconstructive procedures involve ______________________________.

    a. moving structures

    b. joining or connecting structures

    c. rebuilding structures

    d. revamping structures

Objective 27

33. How many degrees of freedom are required to position a robotic arm to a specific point in space?

    a. 2

    b. 3

    c. 4

    d. 5

Objective 28

34. Which of the following is a function of the Y-axis?

    a. open, close

    b. up, down

    c. left, right

    d. in, out

Objective 42

35. What should the surgical technologist do to prepare the robotic arm(s) for surgery?

   a. cable up all connections, position and connect user interface controls, power up the system and ensure system is functional after boot up

   b. position and connect user interface controls, cable up all connections, power up the system and ensure system is functional after boot up

   c. cable up all connections, power up the system and ensure system is functional after boot up, establish a sterile field

   d. position and connect user interface controls, power up the system and drape the robotic arms, cinching them tight

Objective 4

36. Which of the following is a term for the real-time relay of internal surgical data to the OR team?

   a. computer-generated navigation

   b. image-enhanced navigation

   c. computer-aided surgery

   d. image-guided surgery

Objective 20

37. The delay of information between the surgeon, the AMS, and the patient is known as ________________.

   a. impedance

   b. latency

   c. postular technique

   d. inhibition

Objective 26

38. Mechanical driving systems for robotics rely on ________________.

   a. pulleys

   b. gears

   c. servo systems

   d. both a and b

Objective 4

39. In which of the following stages of surgery is digital data collection most useful?

   a. pre-operative stage

   b. peri-operative stage

   c. post-operative stage

   d. none of the above

Objective 25

40. Prismatic action is ________________ in nature.

a. rotational

b. revolute

c. spherical

d. translational

Objective 5

41. A robot is comprised of a ____________ system of ________, links and joints that respond to a controller through mechanical or electrical means.

a. complex, mechanisms

b. high-tech, motors

c. broad-based, controllers

d. mechanical, manipulators

Objective 8

42. The use of surgical robotics increases precision by at least ____________.

a. 10 times

b. 20 times

c. 50 times

d. 75 times

Objective 13

43. What is the typical size of incisions for diagnostic MIS procedures?

a. 1–5 mm

b. 2–5 mm

c. 2–10 mm

d. 5–30 mm

Objective 16

44. Which of the following statements is true concerning the difference in surgical stance between flexible and rigid stem graspers?

a. flexible stem graspers allow the surgeon to drop the elbows to a relaxed position

b. rigid stem graspers force the surgeon to modify leg and hip positions and hold the body symmetrically

c. flexible stem graspers increase fatigue

d. rigid stem graspers ease the tension the surgeon holds in shoulders and upper arms

Objective 6

45. Miniaturization is one of the hallmarks of ________________.

a. modern medical research
b. neurosurgical procedures
c. surgical robotics
d. surgical tool manufacturers

Objective 26

46. Electrical driving systems for robotics rely on ___________.

a. pulleys
b. gears
c. servo systems
d. both a and b

Objective 12

47. What is the typical recovery time frame for MIS procedures?

a. 1 week
b. 2 weeks
c. 4 weeks
d. 6 weeks

Objective 23

48. Two-way links between which of the following two components ensure the control program knows the precise robotic arm position?

a. actuators and activators
b. actuators and sensors
c. sensors and computer
d. computer and user

Objective 6

49. Scaling is the ______________________.

a. ability to abrade tissue one layer at a time
b. replication of the surgeon's movements on a microscopic level with extreme precision
c. precise sizing of instruments to microscopic levels
d. function of connecting the surgeon's console with robotic movements

Objective 24 50. Visual sensors _________ images and ________ these to the controller.

a. process, transpose

b. register, enhance

c. interpret, relay

d. none of the above

Objective 4 51. Simulation is the most helpful in ____________________.

a. modeling tissue

b. preparing the surgeon for specialized surgery

c. synchronizing catheter and needle placement

d. all of the above

Objective 12 52. Post-operative benefits of robotics include ____________ and _____________.

a. improved outcome, cutting edge technology

b. cutting edge technology, review of surgery

c. review of surgery, cutting edge technology

d. reduced complications, improved outcome

Objective 11 53. In which of the following areas does robotic micro-dexterity have the largest impact?

a. surgery involving the head and neck

b. surgery involving the eyes and ears

c. surgery involving the thoracic and reproductive areas

d. surgery involving the heart and lungs

Objective 13 54. What is the typical size of incisions for therapeutic MIS procedures?

a. 1–5 mm

b. 2–5 mm

c. 2–10 mm

d. 5–30 mm

Objective 15

55. Which statement most accurately describes a flexible scope?

   a. a tube using light-emitting diodes to view internal structures

   b. a narrow, hollow tube designed for viewing in the forward direction

   c. tubing that can shape to various body contours, while allowing multiple viewing angles

   d. a scope that can inch its way along an intestine or other body orifice for better viewing

Objective 4

56. Micro-dexterity is the application of ____________ to specific tasks that require a greater degree of ____________ than is humanly possible.

   a. digital enhancement, magnification

   b. computer-aided surgery, accuracy

   c. new technology, precision

   d. none of the above

Objective 18

57. What is the most common rationale for using a robotic arm for laparoscopic surgery?

   a. steady visual image

   b. established landmarks

   c. surgical stance

   d. all of the above

Objective 7

58. After anatomical data has been separated into specific organs, structures and tissues, and surgical navigational points have been assigned, what is the next step in the sequence?

   a. build computer-aided 3D anatomical structures

   b. establish image-guided tracking of surgical instruments relative to said points

   c. match registration to patient position

   d. perform surgery

Objective 17

59. The surgeon's movements are ______________ during MIS, and as this increases, ____________ increases as well.

   a. restricted, shearing

   b. magnified, momentum

   c. amplified, torque

   d. dulled, risk

Objective 21

60. AMS stands for ___________________________.

    a. Articular Medical Scope

    b. Arthroscopic Membranous Surgery

    c. Articulated Mechanical System

    d. Angular Mucocutaneous Sigmoidoscope

Objective 17

61. The connection that provides the surgeon a sense of touch through remote tools is known as a _______________________.

    a. teleconnection

    b. haptic interface

    c. systems interface

    d. telesurgery

Objective 28

62. Which of the following is ONLY a function of the end effector?

    a. open, close

    b. up, down

    c. left, right

    d. in, out

Objective 22

63. Which of the following is NOT a part of the robot?

    a. joints

    b. user interface

    c. links

    d. end-effector

Objective 13

64. The typical number of incisions for open surgery is _______, whereas the typical number of incision for MIS surgery is ________.

    a. 1 to 3, 1 to 4

    b. 1 to 2, 3 to 4

    c. 1 to 3, 3 to 5

    d. 1 to 4, 2 to 3

Objective 4

65. Exerting direct surgical control from a distance is called ________________.

a. telecommunication

b. telepresence

c. teleconnection

d. telesurgery

Objective 33

66. When the surgeon overrides the robotic system for a segment of the procedure, the AMS is in _________ control mode.

a. manual

b. shared

c. autonomous

d. collaborative

Objective 20

67. Which of the following has the potential to make the use of robotics awkward and cumbersome?

a. surgical stance

b. patient positioning

c. robotic control

d. latency

Objective 8

68. Telementoring allows ________________ to ___________ other surgeons.

a. specialists, communicate with

b. mentors, telephone

c. specialists, assist

d. mentors, encourage

Objective 24

69. Which of the following categories can sensors fall into?

a. tactile

b. proximity

c. thermal

d. all of the above

Objective 5

70. Select the statement that best describes what head and neck surgery, telesurgery, and microsurgery all have in common.

   a. such procedures are surgical in nature

   b. such procedures are made more difficult because of minimal access and may require microscopic intervention

   c. such procedures are extremely demanding and may incur high levels of fatigue

   d. such procedures are best handled by a few specialists

Objective 41

71. Which of the following should be the third in the sequence of preparatory steps for a robotic procedure?

   a. position equipment

   b. position table

   c. position patient

   d. drape equipment

Objective 23

72. The function of ___________ is to drive the task to be performed.

   a. actuators

   b. links

   c. sensors

   d. end-effector

Objective 14

73. Which of the following best describes the function of a laparoscope?

   a. a cable that carries laser light from a source to a destination

   b. a type of endoscope that is used for viewing internal and abdominal tissue or cavity for MIS procedures

   c. a tube that allows therapeutic light to penetrate internal tissues

   d. a scope that can be inserted through natural orifices such as the nose or throat for diagnostic analysis

Objective 37

74. Which most closely describes the means of designating robotic coordinates for movement to a specified location?

   a. structures

   b. landmarks

   c. physical anomalies

   d. all of the above

Objective 27

75. What is the proper sequence of events leading to robotic manipulation?

   a. position, manipulate, orient
   b. position, orient, manipulate
   c. orient, position, manipulate
   d. orient, manipulate, position

Objective 40

76. Which of the following tools are potentially used during an MIS procedure?

   a. coagulator
   b. dissection tools
   c. retraction tools
   d. all of the above

Objective 17

77. When extenders become entangled during MIS procedures this is called __________.

   a. entwined
   b. cross-canted
   c. sword fighting
   d. none of the above

Objective 35

78. For 3D visualization of what is essentially a 2D view, ____________ is often used.

   a. special polarized glasses
   b. head-mounted viewer
   c. both a and b
   d. none of the above

Objective 40

79. Which of the following tools is unique to MIS procedures?

   a. irrigator
   b. laparoscopic ultrasound wand
   c. coagulation
   d. laser

Objective 28

80. Which of the following is a function of the Z-axis?

a. open, close
b. up, down
c. left, right
d. in, out

Objective 39

81. Which of the following is NOT a basic imaging tool used in MIS procedures?

a. visual system
b. endoscope
c. fluoroscope
d. high resolution monitor

Objective 5

82. Even though other factors play a role in pushing the medical community towards minimally invasive surgery, which of the following factors exert the most influence?

a. patient pressure, based on reduction of risk, less pain and faster recovery
b. pressure from surgeons for progressive procedures that enhance surgical precision
c. OR staff pressure to optimize and simplify high volume procedures that most benefit from MIS
d. neurosurgeons and cardiovascular surgeons want the latest technology to assist in reducing patient risk and enhancing surgical precision

Objective 30

83. How many degrees of freedom are in the human wrist?

a. 1
b. 2
c. 3
d. 4

Objective 27

84. The orienting mechanism of a serial robot is the ____________.

a. joint
b. arm
c. wrist
d. end effector

Objective 15

85. Which of the following is an example of a rigid scope?

a. electroscope, laparoscope

b. ultrasonic endoscope, fiberscope

c. endo-periscope

d. flexible video-endoscope

Objective 25

86. __________ move, based on prompting from drivers and are brought together through joints.

a. Fingers

b. Links

c. Stylus

d. End effectors

Objective 38

87. In the da Vinci diagram, the surgical technologist is located ________________.

a. next to the surgeon

b. across from the assistant

c. at the foot of the operating table

d. by the anaesthesiologist

Objective 6

88. Which of the following is NOT a characteristic of surgical robotics?

a. the ability to accurately repeat the same procedure

b. the lack of need for image-guided surgery

c. the lack of need for respite

d. the ability to manage microscopic movement without tremor

Objective 19

89. Dexterity-enhancing robotics are used to ________________________.

a. assist in precise navigation

b. assist in performing tasks that are too small for human hands alone

c. enhance surgical accuracy or increase dexterity

d. all of the above

Objective 25

90. Joints require ____________ to register its actions.

    a. fingers
    b. links
    c. sensors
    d. end effectors

Objective 33

91. When the surgeon specifies a particular action that is a deviation from the programmed path, movement is restricted to __________, while the AMS ________________.

    a. one axis, retains control of the other axis
    b. the computed axis, responds to the surgeon's deviation
    c. the intervention, performs the task requested of it
    d. two axes, functions normally

Objective 7

92. Which of the following steps is a mandatory part of integrating robotics into hip replacement procedures?

    a. acquire patient specific anatomical data
    b. registration of landmarks
    c. both a and b
    d. neither a nor b

Objective 34

93. Which of the following are the three primary processors involved in running an AMS?

    a. imaging, information, and control
    b. imaging, programming, and control
    c. imaging, mechanical, and electrical
    d. movement, motors, and programming

Objective 13

94. What is the typical size of incisions for open abdominal procedures?

    a. 1–5 cm
    b. 2–10 cm
    c. 5–20 cm
    d. 10–40 cm

Objective 32

95. How many degrees of freedom must an articulated robotic arm have to perform basic movements?

a. 2

b. 4

c. 6

d. 8

Objective 30

96. How many degrees of freedom are in the human shoulder?

a. 1

b. 2

c. 3

d. 4

Objective 7

97. Registration makes use of ________________ that assist in surgical navigation.

a. metal pins or structural anomalies

b. image-guided tracking systems

c. ferrite beads

d. specialized logistical programs

Objective 37

98. Which term is used interchangeably with 'landmark'?

a. frame of reference

b. metal marker

c. coordinates

d. structures

Objective 21

99. Which of the following is NOT a primary robotic component?

a. high resolution monitor

b. power source

c. program and controller

d. AMS

Objective 35 100. The user interface for a robotics system is generally a ________________.

a. voice controlled system

b. eye controlled system

c. haptic interface

d. all of the above

Objective 9 101. Which of the following is NOT a type of surgery best suited for robotics?

a. obstetric surgery

b. ophthalmic surgery

c. orthopedic surgery

d. neurosurgery

Objective 31 102. How many degrees of freedom are in a rigid endoscope?

a. 1

b. 2

c. 3

d. 4

Objective 10 103. Imaging and __________ modeling of anatomical structures assist in determining location of anomalies.

a. soft 2D

b. firm 3D

c. firm 2D

d. soft 3D

Objective 29 104. Rotational motion is called ________________.

a. yaw

b. pitch

c. roll

d. pivot

Objective 36

105. Sensate feedback is a critical component in successful surgery. What component provides a modified sense of touch?

a. joystick

b. haptic interface

c. sensors

d. special mouse

Objective 29

106. Rotational and prismatic motion that moves left and right is called ______________.

a. yaw

b. pitch

c. roll

d. pivot

Objective 34

107. The user interface of a robotic system may be controlled __________________.

a. vocally

b. optically

c. electronically

d. all of the above

Objective 30

108. How many degrees of freedom are in the human elbow?

a. 1

b. 2

c. 3

d. 4

***Permission to duplicate this module review is granted.**

## Answers to Module Review

1. a
2. a
3. c
4. b
5. c
6. a
7. b
8. d
9. a
10. d
11. c
12. b
13. c
14. c
15. a
16. c
17. a
18. a
19. d
20. a
21. d
22. c
23. c
24. c
25. b
26. a
27. c
28. a
29. c
30. c
31. d
32. b
33. b
34. b
35. a
36. d
37. b
38. d
39. a
40. a
41. d
42. a
43. c
44. a
45. c
46. c
47. a
48. c
49. b
50. c
51. d
52. d
53. a
54. d
55. c
56. c
57. d
58. c
59. b
60. c
61. b
62. a
63. b
64. c
65. d
66. d
67. d
68. c
69. d
70. b
71. d
72. a
73. b
74. d
75. b
76. d
77. c
78. c
79. b
80. d
81. c
82. a
83. c
84. c
85. a
86. b
87. c
88. b
89. d
90. c
91. a
92. c
93. a
94. d
95. c
96. c
97. a
98. a
99. a
100. d
101. a
102. d
103. d
104. c
105. b
106. a
107. d
108. a

# Introduction to Surgical Technology

Student Edition

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# Introduction to Surgical Technology

## Third Edition

## Student Edition

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# Introduction to Surgical Technology

## SECTION A:
## Orientation to Surgical Technology

### Module 1-A: Professional Responsibilities and Relations

## Module Contents

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**PREREQUISITES:**
**None**

## Learning Activities Sheet

Student name ______________________________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Read** Student Supplement 1, "Student Lifestyle Considerations," and Student Supplement 2, "Desirable Traits and Special Demands of the Surgical Technologist." Discuss any questions or concerns you may have with your instructor.

☐ 5. **Study** Information Sheet, Objective 1 through Objective 6.

☐ 6. **Research** Online resources to learn more about professional responsibilities and relations of a surgical technologist. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________

☐ 7. **Do** Assignment Sheet 1, "Draw an Organizational Chart of the OR Suite for a Typical Hospital."

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, repeat steps 5 and 7.

☐ 9. **Read** Student Supplement 3, "Ways to Promote Professionalism."

☐ 10. **Study** Information Sheet, Objective 7 through Objective 16.

☐ 11. **Take** Written Test provided by your instructor.

☐ 12. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat steps 5, 10, and 11.

☐ 13. **Do** Assignment Sheet 2, "Distinguish Among Duties of the Surgical Team Members."

☐ 14. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 15. If the evaluation is not satisfactory, repeat steps 10 and 13.

☐ 15. **Do** Assignment Sheet 3, "Research Professional Health Care Associations and Their Magazines/Journals."

☐ 16. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 17. If the evaluation is not satisfactory, repeat step 15.

☐ 17. **Do** Assignment Sheet 4, "Research Organizations That Provide Health Care Support."

☐ 18. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 19. If the evaluation is not satisfactory, repeat step 17.

☐ 19. **Read** Student Supplement 4, "How to Get a Job and Keep It." Check with your instructor to see if you will be preparing a résumé or other items for seeking a position as part of this module.

☐ 20. **Check** With your instructor for any additional assignments to be completed.

☐ 21. **Do** Additional assignments your instructor lists below.

________________________________________

________________________________________

________________________________________

☐ 22. **Take** Module Review provided by your instructor.

☐ 23. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 24. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to describe a typical hospital organizational plan and distinguish among duties of the surgical team members. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. State the primary goal of surgical intervention.
2. Match reasons for surgical intervention to their correct descriptions.
3. List the three main types of hospitals and describe each.
4. List facilities where surgery can be performed.
5. Describe a typical hospital organizational chart.
6. Describe a typical hospital organizational structure for surgical services.
7. List hospital departments on which the surgical suite depends to give continuity of patient care.
8. List the members of the surgical team.
9. Distinguish between sterile and unsterile surgical team members.
10. Match surgical team members to their functions.
11. List areas of employment for the surgical technologist.
12. List ways of receiving training as a surgical technologist.
13. Define and state the purpose of a job description for a surgical technologist.
14. Select job responsibilities and functions of the scrub role.
15. Select job responsibilities and functions of the circulator.
16. List limitations of the surgical technologist.
17. Draw an organizational chart of the OR suite for a typical hospital. (Assignment Sheet 1)
18. Distinguish among duties of the surgical team members. (Assignment Sheet 2)
19. Research professional health care associations and their magazines/journals. (Assignment Sheet 3)
20. Research organizations that provide health care support. (Assignment Sheet 4)

## Information Sheet

OBJECTIVE 1 **State the primary goal of surgical intervention.**

- **The primary goal of surgical intervention is to allow the patient to return to his/her best possible state of physical and mental health.**

  ✔ **NOTE:** It is recognized that not every patient will return to a state of wellness due to the nature of some terminal illnesses. In these cases, the health team members will work together to ease the patient's pain and discomfort.

OBJECTIVE 2 **Match reasons for surgical intervention to their correct descriptions.**

1. **Diagnostic**—To determine the nature and cause of an illness
2. **Palliative**—To relieve or alleviate **symptoms**, without curing the underlying cause or disease
3. **Prophylactic** (preventive)—To prevent the occurrence of a disease or illness
4. **Restorative** (curative)—To regain the patient's health and strength, so the patient may resume normal daily activities

KEY TERM

**Symptom**—Subjective indication of a disease or a change in condition as perceived by the patient

✔ **NOTE:** Some symptoms are accompanied by objective signs such as skin rashes or numbness of body parts.

OBJECTIVE 3 **List the three main types of hospitals and describe each.**

✔ **NOTE:** Hospitals can be general in nature or specialized in particular areas. Specialized hospitals that treat one type of health problem, or limit their care to one type of patient include children's hospitals, burn centers, and **hospices**.

KEY TERM

**Hospice**—A program that provides for mental and physical needs of terminally ill patients

1. **Nonprofit**—Affiliated with religious or other nonprofit organizations; cost of patient care is offset by charitable donations, and income is not taxed because any profits are returned to hospital to cover operating expenses

   ✔ **NOTE:** A nonprofit hospital may also be tax-supported.

   Examples: St. Jude Children's Research Hospital, Shriner's Hospital for Crippled Children, and many university hospitals

2. **Proprietary**—Privately owned and usually managed by a **corporation**; income is taxable and investors are entitled to a share of the **profits**

KEY TERMS

**Corporation**—A group of people acting under charter (a document issued by an authority such as the legislature) on behalf of a single entity such as a hospital or clinic; organization, not individuals, is responsible for any liabilities

**Profit**—Monetary gain after all expenses have been met

3. **Tax-supported**—Receive funding from federal, state, or local governments

   Examples: Veteran's Administration (VA) hospitals, university hospitals, and county hospitals

   ✔ **NOTE:** University-supported hospitals are frequently engaged in medical research projects and training programs for students entering health professions and occupations.

OBJECTIVE 4 **List facilities where surgery can be performed.**

✔ **NOTE:** Most people associate **surgery** with extended stays in a hospital. However, because of the high cost of long-term hospital care and the increasingly routine nature of many procedures, surgery is frequently performed on an **outpatient** or **ambulatory** basis.

KEY TERMS

**Surgery**—Branch of medicine dealing with manual and operative procedures to correct deformities and defects, to repair injuries, and to diagnose and cure diseases

**Outpatient**—A patient who receives treatment at a hospital, surgical center, or clinic without being hospitalized

**Ambulatory**—Ability to walk and move about; not confined to bed

1. **Hospital-based units**—Surgical suites within or attached to a hospital

   - Self-contained units—Operating rooms for ambulatory care are separated from **inpatient** surgical suites

- Combined units—Outpatients share the same operating room suite and other hospital facilities with inpatients, but have a separate **preoperative** holding area

KEY TERMS

**Inpatient**—A patient who has been admitted to a hospital or other health care facility for treatment requiring an overnight stay

**Preoperative**—Before surgery

2. **Satellite surgery center**—Facility that is owned and operated by a hospital, but that is physically separated from the hospital
3. **Freestanding ambulatory surgery center**—Independent facility that is privately owned and operated, often by a group of physicians
4. **Office-based surgery center**—Part of a physician's office that is equipped to perform surgery
5. **Ambulatory care center/surgicenter**—A facility designed to deliver care to a patient who is not confined to bed or in need of formal admission to a facility for a prolonged period of time

   ✔ **NOTE:** Terms used to describe ambulatory care include same-day surgery, outpatient surgery, and ambulatory surgery.

6. **Clinic**—A facility for diagnosis and treatment of outpatients; may be a group practice in which several physicians work cooperatively or a single doctor's office

OBJECTIVE 5 **Describe a typical hospital organizational chart.**

1. **The operating room (OR) where surgical intervention is performed is only one part of the larger unit, the operating room suite.**
2. **The operating room suite, similarly, is only one part of the larger unit, the medical facility.**
3. **Many people function in the medical facility, in both direct and indirect relationship with the patient.**
4. **Every employee's job is important, and each person has a job to perform that fits into the general scheme of the medical facility.**
5. **The surgical technologist should know his/her relationship to other individuals and departments in the medical facility.**
6. **Each medical facility, no matter how large or small, develops an organizational chart to show how all employees and their departments are related to the whole facility.**

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7. The organizational chart demonstrates the direct and associated lines of authority and is a pattern of control that links together responsibilities within the structure.

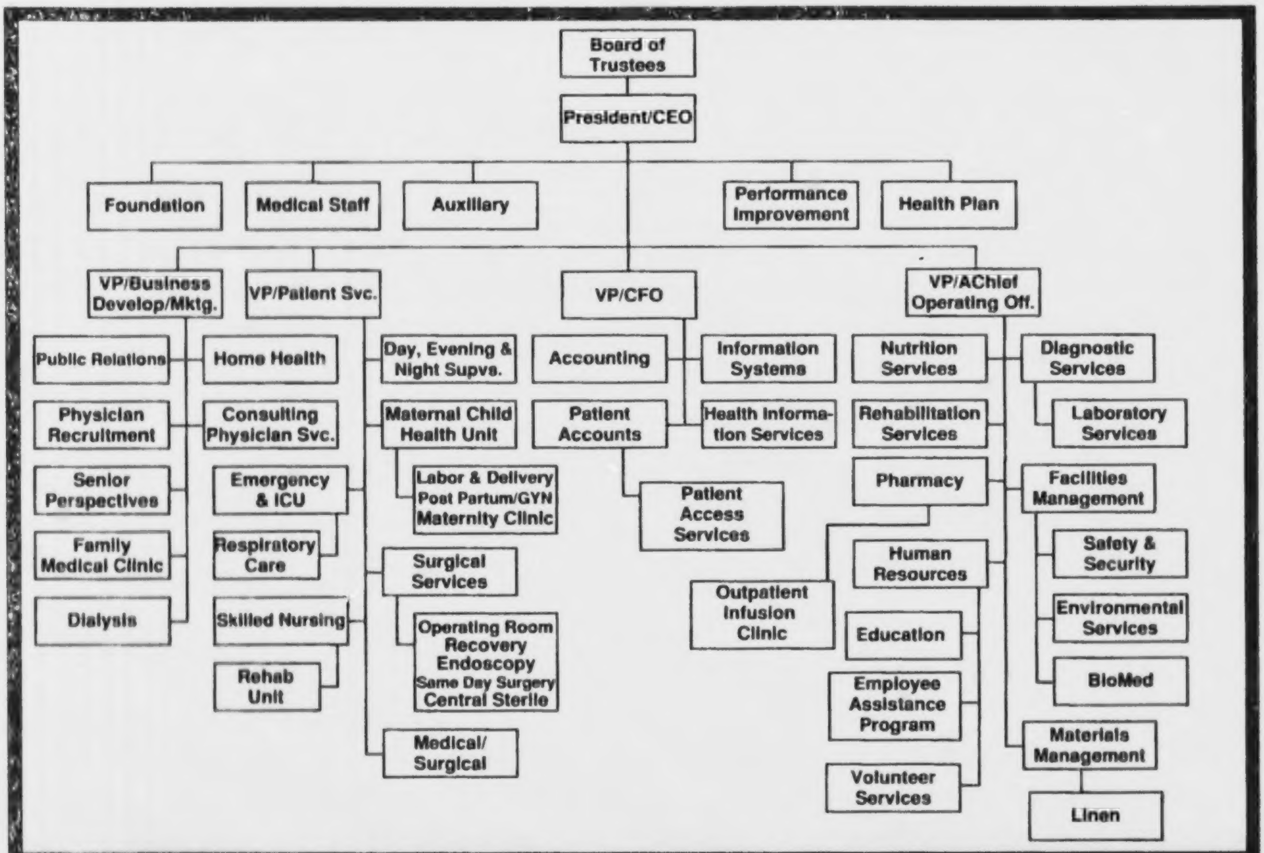
Board of Trustees
President/CEO
Foundation
Medical Staff
Auxiliary
Performance Improvement
Health Plan
VP/Business Develop/Mktg.
VP/Patient Svc.
VP/CFO
VP/AChief Operating Off.
Public Relations
Physician Recruitment
Senior Perspectives
Family Medical Clinic
Dialysis
Home Health
Consulting Physician Svc.
Emergency & ICU
Respiratory Care
Skilled Nursing
Rehab Unit
Day, Evening & Night Supvs.
Maternal Child Health Unit
Labor & Delivery Post Partum/GYN Maternity Clinic
Surgical Services
Operating Room Recovery Endoscopy Same Day Surgery Central Sterile
Medical/ Surgical
Accounting
Patient Accounts
Patient Access Services
Information Systems
Health Information Services
Nutrition Services
Rehabilitation Services
Pharmacy
Outpatient Infusion Clinic
Human Resources
Education
Employee Assistance Program
Volunteer Services
Diagnostic Services
Laboratory Services
Facilities Management
Safety & Security
Environmental Services
BioMed
Materials Management
Linen

Figure 1
Example of an organizational chart for a medical facility

Courtesy of Stillwater Medical Center, Stillwater, Oklahoma.

8. It is important that everyone within the organization follow the lines of authority when dealing with a problem. By using the appropriate method, the immediate supervisor can take action to accomplish the goals of the department.

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OBJECTIVE 6

## Describe a typical hospital organizational structure for surgical services.

✔ **NOTE:** The surgical services organization is made up of surgeons, nursing staff, anesthesia personnel, **allied health** professionals, and ancillary personnel. In addition to individual surgical teams, the overall organization includes other health care professionals who supervise, operate, and maintain the OR suite.

KEY TERM

**Allied health**—Health care workers other than physicians, dentists, podiatrists, and nurses who have special training in the performance of supportive health care tasks

1. **Director of Surgical Services**—May be a physician or registered nurse who is directly responsible for everything and everyone in the operating room suite
2. **Outpatient Surgical Services Clinical Manager**—Usually a registered nurse who assists the Director of Surgery with the management of the Outpatient OR suite; also known as the Outpatient Surgical Services Clinical Supervisor
3. **Operating Room Clinical Manager**—Usually a registered nurse who assists the Director of Surgery with the management of the OR suite; also known as the Operating Room Supervisor or Nurse Manager
4. **Assistant Clinical Manager**—Usually a registered nurse who assists the Operating Room Clinical Manager with the management of the OR suite; also known as the Assistant Clinical Supervisor
5. **Post Anesthesia Recovery Unit Clinical Manager**—Usually a registered nurse who assists the Director of Surgical Services with the management of the post anesthesia recovery unit
6. **Business Manager**—Usually a person with an MBA (Masters in Business Administration) who assists the Director of Surgery or Hospital Administrator with the management of daily operational and indirect patient care functions in the perioperative environment
7. **Staff nurses**—Usually registered nurses who perform nursing activities in the perioperative, intraoperative, and postoperative phases of the patient's surgical experiences
8. **Surgical technologists**—Members of the surgical team who are responsible for delivering patient care and assuming appropriate responsibilities before, during, and after surgery
9. **Patient care assistants**—Unlicensed trained workers who clean, process, and store instruments and supplies; perform housekeeping duties; and assist with the transportation and positioning of patients
10. **Clerical personnel**—Ancillary workers (support staff) who maintain records and reports, order supplies, and assist in scheduling surgeries

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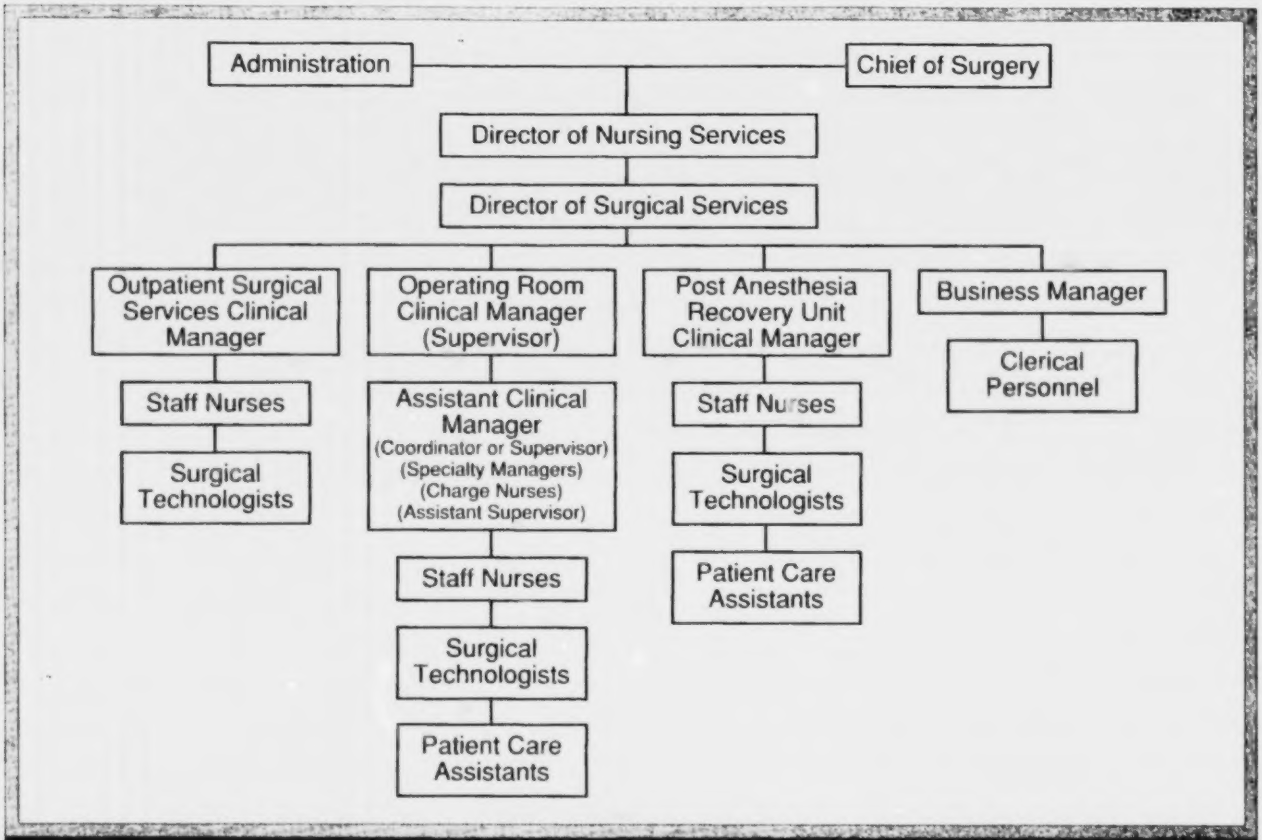
Administration
Chief of Surgery
Director of Nursing Services
Director of Surgical Services
Outpatient Surgical Services Clinical Manager
Operating Room Clinical Manager (Supervisor)
Post Anesthesia Recovery Unit Clinical Manager
Business Manager
Staff Nurses
Surgical Technologists
Assistant Clinical Manager (Coordinator or Supervisor) (Specialty Managers) (Charge Nurses) (Assistant Supervisor)
Staff Nurses
Surgical Technologists
Patient Care Assistants
Staff Nurses
Surgical Technologists
Patient Care Assistants
Clerical Personnel

**Figure 2**
Example of a typical OR suite organizational chart

OBJECTIVE 7

**List hospital departments on which the surgical suite depends to give continuity of patient care.**

1. **Direct patient care**

   - Nursing care units—Provide nursing assistance to patients
   - Diagnostic imaging—Provides X rays, CT scans, mammograms, MRI, bone density scans, ultrasound images, nuclear medicine, etc.
   - Blood bank—Dispenses blood and its components for transfusion
   - Pathology—Examines specimens to determine nature and extent of disease
   - Clinical laboratory—Performs viral, microbiological, metabolic, molecular, and other tests on patient blood, fluids and tissue samples
   - Pharmacy—Dispenses medicines for perioperative use
   - Physical/Occupational therapy—Rehabilitates the patient to achieve optimal daily living

2. **Indirect patient care**
   - Housekeeping—Keeps hospital facilities clean, safe, and orderly
   - Maintenance—Repairs and maintains equipment and facilities
   - Purchasing/Central services—Issues disposable medical/surgical supplies and reprocesses reusable instruments
   - Administration—Manages the financial aspects and institutes policies and procedures
   - Food service—Provides nutritional support
   - Medical records—Maintains patient records

OBJECTIVE 8

**List the members of the surgical team.**

1. **Surgeon**
2. **Assistants to the surgeon**
   - Physician first assistant
   - Nonphysician first assistant
   - Second assistant to surgeon
3. **Scrub person**
4. **Anesthesia provider**

KEY TERM

**Anesthesia**—Partial or complete loss of feeling, especially with sensitivity to pain, with or without loss of consciousness; may be administered as topical, local, regional, or general dependent on nature of treatment or surgery

5. **Circulator**
6. **X-ray technician, pathologist, or other specialists as needed**

KEY TERM

**Pathologist**—A physician who specializes in the study of disease

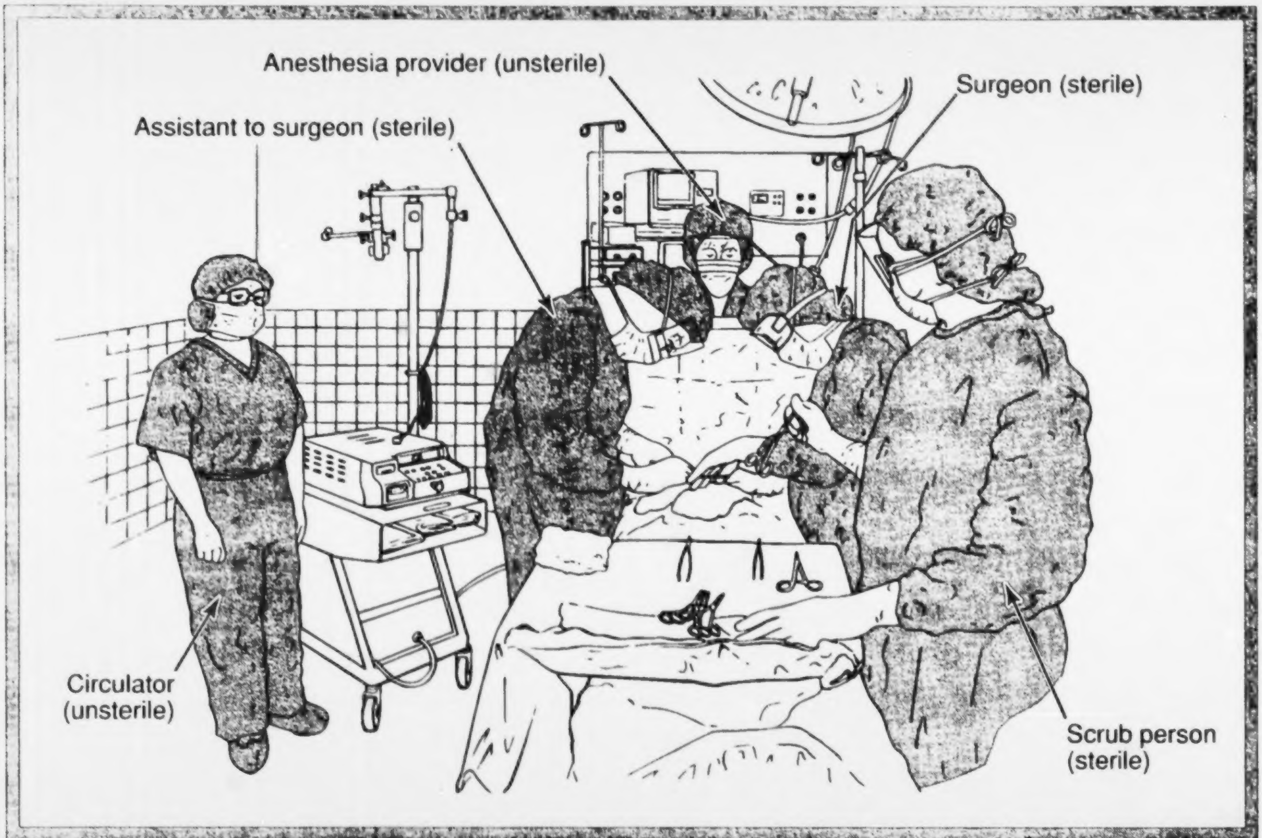
Anesthesia provider (unsterile)
Surgeon (sterile)
Assistant to surgeon (sterile)
Circulator (unsterile)
Scrub person (sterile)

**Figure 3**
Operating room (OR) team members

OBJECTIVE 9 **Distinguish between sterile and unsterile surgical team members.**

1. **Sterile team members wash their hands and arms and put on sterile gowns and gloves before entering the sterile field. They function within the sterile field and handle only sterile items. Sterile team members include:**
   - Surgeon
   - Assistants to the surgeon
   - Scrub person

KEY TERMS

**Sterile**—Free from living microorganisms

**Sterile field**—The area of the operating room where surgery is performed; involves sterile supplies and equipment, furniture covered with sterile drapes, and personnel properly dressed in sterile attire

2. **Unsterile team members function outside the sterile field, but assume responsibility for maintaining sterile technique during the operative procedure. They handle only supplies and equipment that are not considered sterile. They obtain needed supplies for the sterile team. Unsterile team members include:**

   - Anesthesia provider
   - Circulator
   - X-ray technician or other specialists as needed

OBJECTIVE 10

**Match surgical team members to their functions.**

1. **Surgeon**—Performs operative procedures and directs the OR team; must be a licensed physician (MD), **osteopath** (DO), **oral surgeon** (DMD or DDS), or **podiatrist** (DPM) with special training

KEY TERMS

**Osteopath (DO)**—A doctor who practices osteopathy, which is a system of medical practice based on a theory that diseases are mainly due to a loss of structural integrity which can be restored first by manipulation of the body parts and second by the use of therapeutic measures such as physical, medicinal, and surgical techniques

**Oral surgeon**—Dentist with advanced specialty education and training to perform oral and maxillofacial surgery

✔ **NOTE:** The oral surgeon's dental degree may be a DDS (Doctor of Dental Surgery) or DMD (Doctor of Dental Medicine), depending on the school.

**Podiatrist (DPM)**—A physician who specializes in the care of conditions and functions of the human feet; may perform surgical procedures, prescribe corrective devices and drugs, and physical therapy

2. **Assistants to the surgeon**—Assist (directly or indirectly) with surgical procedures in operating room

   - **Physician First Assistant**—Must have the same credentials as the surgeon

     ✔ **NOTE:** If the surgeon should become unable to perform the necessary duties of patient care, a physician first assistant is capable of assuming the responsibilities of the surgeon.

   - **Nonphysician First Assistant**—A specially trained nonphysician allied health care worker who is qualified to perform procedures in the operating room and in other areas of care of the surgical patient; can be a Certified Nurse Operating Room (CNOR) or a Certified Surgical Technologist (CST)

     Examples of nonphysician first assistants:

     — Registered Nurse First Assistant—Certified Nurse Operating Room (CNOR) who has completed training and has successfully completed the first assist examination

  - Certified Surgical Technologist First Assistant (CST/CFA)—Certified Surgical Technologist who has received special training to first assist and has passed a national examination
  - Physicians Assistant (PA)—Generic term used to denote a nonphysician first assistant; has completed a master's degree program and two years of training

- ***Second Assistant to Surgeon***—*A qualified surgical technologist or nurse,* working under supervision of the surgeon, who is not involved in the actual performance of the procedure, but assists the surgeon by retracting tissue and suctioning body fluids to provide proper exposure of the operative site

3. **Anesthesia provider**—Administers anesthesia to the surgical patient; can be a licensed physician (anesthesiologist) or a Certified Registered Nurse **Anesthetist** (CRNA)

KEY TERM

**Anesthetist**—RN who has completed a two-year program to administer an anesthetic

4. **Scrub role**—Prepares the sterile field, scrubs and gowns the members of the surgical team, and prepares and sterilizes the instruments before and after the surgical procedure; works with the surgeon, anesthesiologist, and circulator to provide direct patient care during surgical intervention; can be either a trained surgical technologist, registered nurse (RN), or a licensed practical nurse (LPN)
5. **Circulator**—Responds to the needs of the scrubbed members within the sterile field before, during, and after the surgical procedure; usually performed by a registered nurse with operating room training; can also be a CST or CFA with RN supervision

OBJECTIVE 11 **List areas of employment for the surgical technologist.**

1. **Operating room**
2. **Emergency department/trauma center**
3. **Obstetrics department/labor and delivery room**
4. **Central processing or central service**
5. **Endoscopy unit**
6. **Cardiac catheterization lab**
7. **Tissue and retrieval team**
8. **Burn unit**
9. **Same-day/ambulatory surgery unit**
10. **Freestanding outpatient clinics/surgicenters**

11. Doctors' offices
12. Private scrub for a surgeon
13. Home health care
14. Sales representative (e.g., instrument sales)
15. Instructor in schools of surgical technology

OBJECTIVE 12 **List ways of receiving training as a surgical technologist.**

1. **Career and technical schools**
2. **College (private or public)**
3. **Armed forces**

✔ **NOTE:** In order to become a Certified Surgical Technologist, new applicants must be graduates of programs accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP).

OBJECTIVE 13 **Complete statements concerning the job description of the surgical technologist.**

1. **A job description is a written document that defines the purpose of a position and the scope of work performed, and lists the requirements for the position.**

   ✔ **NOTE:** It is important that the surgical technologist be familiar with his/her job description and keep it up-to-date.

2. **A job description includes: job title; nature of position; duties and responsibilities; educational requirements; credentials required; skills required; and immediate supervisor to whom position is accountable.**

   ✔ **NOTE:** Responsibilities of a surgical technologist position will vary depending upon position being performed, skill or educational level, as well as the rules and operating procedures of the employer.

3. **The purpose of a job description is to outline the job duties of the position, establish the surgical chain of command, and lay out the legal responsibility and accountability for the surgical technologist.**

4. **Job descriptions in the hospital help maintain safe and efficient operations by outlining the specific duties of all personnel.**

5. **All hospital job descriptions must meet the requirements of the Joint Commission of Accreditation of Healthcare Organizations (JCAHO).**

**OBJECTIVE 14** **Select job responsibilities and functions of the scrub role.**

✔ **NOTE:** The person in the scrub role has preoperative, intraoperative, and postoperative responsibilities as summarized below.

1. **Preoperative (before surgery)**
   - Cleans OR, and obtains furniture and equipment
   - Obtains supplies, and opens sterile items needed
   - May assist in transporting and positioning patients
   - Performs surgical hand wash and puts on sterile gown and gloves
   - Prepares sterile field by assembling supplies and equipment
   - Gowns and gloves the surgeon and assistants
   - Assists in draping the patient with sterile drapes
2. **Intraoperative (during surgery)**
   - Passes instruments, supplies, and equipment to surgeon in a prescribed manner
   - Anticipates the surgeon's needs by watching the progress of the surgery, and by knowing the steps of the procedure involved
   - Maintains aseptic technique
   - After receiving medication onto the sterile field from the circulator, prepares and passes medications to surgeon
   - Assists surgeon by retracting tissue, cutting sutures, sponging and suctioning blood from the wound, or irrigating the wound (if qualified and acting as first assistant)
   - Is alert to dangers to the patient
   - Identifies and cares for specimens received during surgery in a prescribed manner
3. **Postoperative (after surgery)**
   - Assists with application of dressing
   - Assists with moving patient to stretcher or bed
   - Performs proper clean up of equipment and supplies
   - May decontaminate and resterilize instruments and supplies
   - Maintains equipment in operating condition, and sends for repairs as needed
   - Maintains stock level of supplies

**OBJECTIVE 15** **Select job responsibilities and functions of the circulator.**

✔ **NOTE:** The circulator stays outside the sterile field and has a number of patient assistance and surgical facilitating responsibilities. The circulator's preoperative, intraoperative, and postoperative responsibilities are summarized below.

1. **Preoperative (before surgery)**
   - Plans, implements, and evaluates preoperative care
   - Assists with opening unsterile supplies before surgery and as needed during surgery
   - Identifies patient, and performs preoperative assessment
   - Provides preoperative education to patient
   - Transports and positions patient on surgery table
   - Prepares the operative site by performing the scrub prep, and possibly the shave prep if needed

     ✔ **NOTE:** Usually the shave prep is done before the patient enters the surgical suite.
   - Assists the anesthesia provider when needed
   - Checks and connects electrical equipment to power sources, and connects suction to vacuum; handles nonsterile ends of equipment
2. **Intraoperative (during surgery)**
   - Is available to sterile team members and anticipates their needs
   - Obtains and prepares all medications needed during the procedure and obtains blood products for transfusion as directed
   - Completes and maintains accurate operative records, including notation of any irregularities and incidents
   - Monitors patient vital signs in local or regional anesthetic cases
   - Observes for any breaks in aseptic technique
   - Is ultimately responsible for the identification and care of specimens received from person in the scrub role
3. **Postoperative (after surgery)**
   - Tapes postoperative dressing
   - May accompany patient to Postanesthesia Recovery Room to give a nursing report of patient's progress, condition, and special equipment requirements

- Performs proper clean up of equipment and supplies
- May decontaminate and resterilize instruments and supplies
- Maintains equipment in operating condition, and sends for repairs as needed
- Maintains stock level of supplies

OBJECTIVE 16 **List limitations of the surgical technologist.**

✔ **NOTE:** Certain responsibilities may only be performed by licensed operating room nurses or physicians as duties are limited by a state's nursing or medical practice acts.

1. **Never administers medication**

   ✔ **NOTE:** Medications are selected and measured by a licensed nurse.

2. **Never administers anesthetic agents**
3. **Never functions in the operating room suite without proper supervision of a qualified registered nurse or physician**
4. **Never clamps tissues, places sutures, or alters body tissues in any way**

   ✔ **NOTE:** This would be considered performing surgery without a license.

5. **Never obtains or administers blood**
6. **Never has final sign-off on operating room documentation**

   ✔ **NOTE:** The supervising nurse must sign all documentation.

7. **Never assesses physical or physiologic status of patient**

## Student Supplement 1—Student Lifestyle Considerations

Your decision to continue your education will provide you with better opportunities for career advancement and personal satisfaction than if you had decided to quit the learning process. In the short term, however, it will likely cause you and your family some elevated degree of personal challenges such as those described in this supplement.

**STRESS**

Any new endeavor is stressful and surgical technology is no different. You are probably being exposed to an entirely new environment that you really didn't know much about. Hundreds of strange terms to understand. A new way of dressing and cleaning up. Weird electronic gizmos to figure out. More types of knives, clamps, and other widgets than you every dreamed possible. The process of learning can be overwhelming. Recognize what is causing you stress and develop relaxation techniques to help you cope.

**FAMILY PRESSURES**

On top of all the studying, there is other stress as well. You won't have much time for family and loved ones as you or they would like. You may have young children that make it difficult to find time for studying. You may have trouble making ends meet and you may wonder if it is worth continuing to spend money on your education when you know there are so many things you or your family may need and want. You may wonder if you will be able to handle it all.

**COMMITMENT**

If you have just moved away from home, you need to make sure you are ready to continue your education. Hopefully, at this point you have thought about it enough and you are ready to commit to the program. Your schooling must be your first priority. If it is not, you are just doing yourself, your education, and future employers a big disservice.

**RULES AND REGULATIONS**

Your surgical technology education is a structured program that forces you to do things in a certain way. Your instructors are not out to make your life miserable. They are using proven educational methods and are teaching techniques that reflect the way business is conducted in the operating room. There is not a lot of room for blazing new trails and doing things your way. The operating room requires you to be a team player under the leadership of the surgeon in charge. You must be comfortable with this concept or you have chosen the wrong educational program.

**RELATING TO OTHER STUDENTS**

We encourage you to reach out and make contact with your fellow students for a number of reasons. First, you need someone other than your instructor who can help you through aspects of learning that you may find particularly challenging. Second, it is very helpful to form study groups to further explore topics, discuss key concepts, memorize terms, and prepare for tests. Next, since your family and friends may not be as receptive to "shop talk" as you may like, it helps to have someone who understands the demands of the surgical technology program and can encourage you in extremely demanding times. Finally, you should start building a network of colleagues in your profession. Good relationships are built under trying, difficult conditions such as your study program. The trusted contacts you make now will help in the future when you need to ask someone about a surgeon's preferences, discuss hospital policy, make contacts at other organizations, and assist you when seeking a new job.

**STUDY HABITS**

While many people want to learn, few really want to study. For most of us, it just is not a whole lot of fun. However, it is essential that you develop good study habits that work for you. Here are a few factors to consider to optimize your studies:

- Environment—Most of us need a quiet, well lit, comfortable area with few distractions. If things are too crazy or uncomfortable where you live, use a library.
- Schedule—Most of us work best when there is a designated study time that we stick with.
- Organization—It generally pays to spend some time keeping your books, papers, supplies, equipment, and study area well organized.
- Note taking—Even when not in class, it is helpful to have a notebook or logbook to record important concepts, phone numbers, Web sites, ideas to check out, action items and to-do lists, and so forth.

**GOOD NEWS**

The good news is that if you devote enough time and effort to it, you most likely will succeed. However, you will need a good support organization to help you through. You and your family need to come to an understanding of the commitment involved. Others may need to help you take some of the "chores" off of you, and they need to understand that you may not have as much time or energy for quality time with your loved ones as either you or they would like.

While we want to stress the seriousness of the surgical technology program, we do realize that you cannot eat, sleep, and breathe your education. Make sure you find a little time for responsible fun as well as personal quiet time. If you do not take an occasional break, you may burn out before you have had a chance to achieve your goal of becoming a surgical technologist.

## Student Supplement 2—Desirable Traits and Special Demands of the Surgical Technologist

Surgical technologists must have certain personal characteristics in order to be successful. Desirable traits and special demands include the following:

- Pay attention to details.
- Be patient and tactful in dealing with patients and recognize the special needs of medicated patients.
- Be willing to perform a variety of tasks, some of which may involve unpleasant conditions or people.
- Be able to work quickly and accurately.
- Possess good physical coordination and manual dexterity.
- Be able to spot flaws or imperfections quickly and accurately.
- Be able to read with understanding, to reason logically, and to use good judgment.
- Be able to prioritize.
- Be able to organize work.
- Be able to do precision work.
- Be able to function in a crisis situation.
- Be able to function under stress.
- Be adaptable and flexible to change.
- Be dependable.
- Be able to communicate effectively.
- Have respect for the rights, privacy, and property of others.
- Be able to observe and report.
- Be able to understand and utilize the necessary equipment.
- Be able to establish and maintain effective relationships with patient, patient's family, doctors, and staff.
- Be willing to continue to learn, and to receive education on the new technology entering the health care industry.

## Personal Requirements and Working Conditions

**PHYSICAL ACTIVITY REQUIREMENTS**

### Constant

- Talking and hearing to exchange information and ideas by means of spoken word both by phone and in person
- Standing while functioning in the scrub role
- Walking, usually at average speed, but occasionally faster, when obtaining supplies, etc.

### Frequent

- Lifting while moving patients, supplies, equipment, etc.
- Kneeling, bending, stooping, crouching while performing perioperative duties (retrieving supplies, counting sponges, changing suction containers, etc.)
- Grasping while handling surgical instruments
- Fingering—working primarily with fingers including sutures, needles, etc.
- Pushing and pulling, while moving patients or equipment
- Climbing while using stairway between locker area and operating room and between inventory control and operating room

**PHYSICAL DEMAND REQUIREMENTS**

- Exerts up to 18 pounds very frequently while lifting instrument trays
- May exert up to 100 pounds of force while lifting patients

**VISUAL ACTIVITY REQUIREMENTS**

- Preparing and reading written documentation
- Working with small sutures, needles, etc.
- Good hand-eye coordination
- Peripheral vision
- Ability to work with microscope
- Subject to extremes in lighting

**INTELLECTUAL AND EMOTIONAL REQUIREMENTS**

- Ability to maintain a high standard of courtesy and cooperation in dealing with co-workers, patients, and visitors, and perform job functions satisfactorily despite the stress of a hospital work environment
- Adaptability to perform a variety of duties, often changing from one task to another without loss of efficiency or composure

- Ability to perform in situations requiring set limits, standards, and strict adherence to established procedures and guidelines
- Ability to perform under stress when confronted with emergency, critical, or unusual situations

**TOOLS AND EQUIPMENT**

- Standard operating room equipment including but not limited to all types of surgical instrumentation, cautery, lasers, microscopes, video systems, and power equipment
- Use of phone, computer terminal, and written material

**WORKING CONDITIONS**

**The student is subject to**

- Inside environmental conditions
- Noise from various types of surgical equipment
- Vibration from drills, saws, etc.
- Hazards from electrical equipment, mechanical parts, lasers, etc.
- Gases and fumes such as bone cement
- Occupational exposure to blood or other potentially infectious material and, therefore, is included in the OSHA Exposure Control Plan with all its specifications for preventing contact with the above material

## Student Supplement 3—Ways to Promote Professionalism

The surgical technologist is a member of a professional team. As such, there are a number of activities that the surgical technologist must do in order to promote professionalism. These include:

- Understand job functions and responsibilities as listed in the job description
- Perform job responsibilities in an ethical and professional manner
- Become certified and remain current
- Participate in professional organizations such as the Association of Surgical Technologists, Inc. (AST)
- Attend and participate in in-service educational programs
- Attend workshops, institutes, and conventions when pertinent to professional growth
- Participate in clinical ladder program if implemented by employer
- Perform community service as it relates to the profession
- Act as a role model for other surgical technologists

In addition to the above, the surgical technologist who is "in demand" possesses the following attributes:

- Reliable—Shows up for work every day, is available when on-call, and is punctual
- Well prepared—Knows the preferences of the surgeon, has all instruments and supplies on hand, and is thoroughly familiar with the facility's equipment
- Professional communication in the OR—Keeps personal business out of the conversation; advises surgeon when new to a procedure
- Integrity—Exercises surgical conscience; acknowledges breaks in technique (either personally or on the part of others) and always acts with ethical behavior
- Positive outlook—Is someone people want to work with
- Team player—Follows orders from superiors as well as helps to provide a cohesive team environment
- Proactive in problem solving—Anticipates problems and helps to find solutions

## Student Supplement 4—How to Get a Job and Keep It

1. **Develop a professional résumé.**

A personal résumé is a detailed record of your work and educational experience. This information is arranged by date from your present job to your least recent job. Your educational experience should also be arranged from most recent to least recent. Additional information such as personal achievements and outside activities and interests should be included only if it is relevant to the position you are applying for. For example, if you were an officer in your school's student health organization or you have volunteered at a local health care facility, you would want to include this on your résumé. A typical résumé includes the following information:

- Position sought
- Name, address, phone number

  ✔ **NOTE:** With the availability of technology today, many applicants are also including their e-mail address.

- Education
- Work experience
- Achievements
- Outside activities and interests
- Availability
- References

There are nearly as many résumé formats as there are applicants. Some applicants have their résumé professionally prepared and printed, but with a little thought and care you can prepare your own résumé so that it presents your experience and qualifications in a professional manner.

✔ **NOTE:** A professional résumé should be expertly typed and free of spelling and grammatical errors.

Today's word processing programs such as Microsoft Word® and Corel WordPerfect® include templates or style sheets specifically designed to help you easily create a professional, attractive résumé. There are also a number of Web sites that offer other résumé templates you can download. These allow you to concentrate on the content you wish to convey, rather than having to worry about choice of fonts, line spacing, and other formatting issues.

**2. Familiarize yourself with the types of correspondence used in the application process.**

✔ **NOTE:** Like the résumé, all letters must be perfect in every way—format, appearance, and content. Again, there are Web sites that offer various formats and styles of letters to assist you in getting the job you really want.

- Letter of inquiry—Letter requesting information about potential opportunities
- Letter of application—Also referred to as a cover letter, this is submitted with or before the completed application form; in it you let the prospective employer know that you are interested in applying for a specific (usually advertised) position.

  ✔ **NOTE:** After receiving this letter, if interested, the prospective employer generally calls to arrange an interview, sends an application form, or tells you where to come to complete an application form.

- Follow-up letter—Letter written after you interview for a job but before you have heard about the prospective employer's hiring decision; in it you thank the employer for the interview and state once more your desire to fill the position for which you interviewed.
- Letter of acceptance or refusal—Letter written after you have been offered a job; in it you formally tell the employer that you will or will not accept the position and its conditions. You may also ask for specific information that will help you begin the job in a knowledgeable and efficient manner.

**3. Complete an application form appropriately.**

The way your job application looks directly influences your chances of getting the job. Employers may not even read an application that is incomplete, contains spelling errors or crossouts, is written in a sloppy, illegible hand, or fails to conform to given directions. An application form usually includes the following:

- Name, address, telephone number
- Social Security Number
- Schools attended, diplomas/degrees earned/dates attended
- Certification/date awarded
- Work experience
  - Company names
  - Locations (addresses)
  - Positions held
  - Duties performed
  - Dates worked
- References

✔ **NOTE:** Personal questions concerning race, creed, color, national origin, sex, age, veteran or marital status, handicaps or disabilities, or sexual preferences may not legally be asked on a job application unless the employer proves that such information is vital to the applicant's ability to perform assigned job duties.

Have phone numbers, addresses, points of contact, relevant employment dates, etc. with you when applying for a job. Before you list someone as a reference, ask them if they will give you a positive referral.

When completing a job application form, it is helpful to read the instructions and read through the entire application before filling it out. You should answer the questions honestly and completely, and be sure to spell correctly. If a question on the application form does not apply to you, write "N/A" in the blank to indicate that you have read the question and did not merely forget to answer it or attempt to avoid it.

Use a pen (either blue or black ink), typewriter, or complete the application online if it is available on the prospective employer's (company's) Web site.

✔ **NOTE:** If using a pen, print neatly and clearly. It is sometimes helpful to fill out a copy of the application first for practice. This helps eliminate errors and messiness.

**SUGGESTION:** If you have taken the application home with you, have someone review it for accuracy, clarity of response, and neatness.

**4. Prepare for the job interview.**

Being interviewed is not always easy. You have only a few minutes to make a good impression. Your attitude, personality, and appearance—as well as your preparation for the interview and your work experiences—are all points that the interviewer looks for and evaluates during the interview. Your behavior before, during, and after the interview will strongly influence the impression you make. In addition to the way in which you handle yourself, the way you answer the questions (not necessarily your qualifications) may lead the interviewer to decide to hire or reject you for the position. Think always of how your experience and qualities can help the organization, not how the organization can help you.

The following recommended practices will help you "sell yourself" during a job interview.

- Prepare for the interview.
- Arrive five to ten minutes early to give yourself a little time for orientation.
- Go to the interview alone, unless otherwise requested.
- Introduce yourself to the receptionist and state the purpose of your visit.
- Greet by name the person who will interview you.
- Shake hands firmly if the interviewer extends the offer.
- Sit down when the interviewer indicates that you should.

- Sit quietly until the interviewer opens the interview.
- Try not to show nervousness.
- Maintain good posture.
- Maintain eye contact with the interviewer.
- Listen carefully and take notes as necessary for a memory aid.
- Do not smoke or chew gum.
- Show a real interest in the job for which you are interviewing.
- Be friendly and use good manners.
- Avoid using slang or offensive language no matter how relaxed the interviewer makes you feel.
- Be ready to talk about your strengths, your individual work experiences, and your special skills.
- Avoid blunt "yes" and "no" answers, and explain your answers fully.
- Discuss positive aspects of yourself, not negative aspects of others or previous employers.
- Wait until the end of the interview to ask the questions you have written down concerning the job.
- When the interviewer concludes the interview, politely thank the interviewer for his/her time and consideration.
- Offer to provide the interviewer with any additional information requested.
- If you are not told, ask when you can expect to hear of the hiring decision.

### RESEARCHING THE PROSPECTIVE EMPLOYER

Before your interview, it is important to learn all that you can about the organization. This information will help you ask the right questions during the interview, which in turn will improve your chances of getting the job you want. It also shows the employer that you take initiative and are resourceful. Some things to look for include the following:

- Name, position, and title of the contact person who will be doing the interviewing
- How to pronounce the interviewer's name
- Whether there will be any pre-employment testing or screening, and if so, a general idea of what to expect
- Typical salary range in this area (state or city) for this type of job
- How long the organization has been in business

- How satisfied other employees are or have been with this employer
- Scope of the organization, specialties, philosophy, etc.

**SUGGESTION:** Use the Internet as one of your tools in researching the organization. Look at the business' Web site and search for newspaper reports or other tidbits of information about the organization. However, exercise a healthy skepticism when reviewing press releases (i.e., biased articles generated by the organization's public relations office) as well as rumors being passed among the organization's employees.

During the interview, you will learn more about the position and the organization, including the following:

- Working conditions such as hours of work, dress regulations, and professional organizations you may be expected to join
- Security and safety precautions
- Brochures or other publicity material that may be available
- Salary or wages
- Fringe benefits
- Opportunity for advancement

### DRESSING FOR THE JOB INTERVIEW

It is very important that the applicant make the best impression possible from the beginning of the interview. Most interviewers form an opinion within the first four to six minutes of the interview. Some guidelines for dressing appropriately for a job interview are listed below.

- Dress complementary to the job for which you are applying.
- Dress better for the interview than you normally would for a day on the job.
- Coordinate your clothing so that the colors, patterns, fabrics, and styles are suitable for your shape and body structure.
- Be modest and well groomed. Wear
    - clean, simply styled hair
    - clean and neatly trimmed nails
    - buttoned shirt or blouse
    - fashionable but modest skirt length
    - well-fitting clothes (not too tight)
    - polished shoes

- Be conservative in your dress and accessories. Avoid wearing
  - the newest fads or overdressing
  - too much makeup
  - too much cologne or aftershave lotion
  - large, flashy jewelry
  - sunglasses

✔ **NOTE:** Most hospitals do not allow multiple piercings and require that visible tattoos be covered.

**POINTS AN INTERVIEWER LOOKS FOR DURING A JOB INTERVIEW**

✔ **NOTE:** The following points are not listed in order of importance. Different employers will place varying degrees of value on the items listed below:

- Preparation
- Qualifications
- Competencies and skills
- Experience
- Attitude
- Poise and ability to handle stress
- Courtesy and interpersonal skills
- Maturity and dependability
- Personal appearance
- Personality
- Neatness and organization
- Flexibility/adaptability
- Commitment
- Attendance and punctuality
- Positive reaction to constructive criticism
- Loyalty

## EVALUATING A JOB OFFER

After all the planning and hard work you put into applying and interviewing for a job, it is very rewarding to be offered the position for which you applied. However, sometimes the job may be offered dependent on your meeting certain requirements that did not become evident until after the interview. Or during the interview, you may have decided that you did not want to work for the employer. Too, you may have received another job offer between the time of the interview and your acceptance for the position. If this is the case, you must decide which of the positions is most advantageous to you. When you are offered a job, you must do some careful thinking before you accept or reject it.

One way to evaluate a job offer is to create a list of the pros and cons related to the job and prospective employer. Think about the location of the job, the hours you would be working, the salary and benefits, opportunities for advancement, the reputation of the health care facility and surgeons who work there. Today, some facilities offer such amenities as on-site child care and wellness centers. Once your list is complete, compare the pros and cons. If the positive aspects of the job far outweigh the negative ones, your decision should be simple. Just remember that you will be entering a working partnership and it is imperative that you make the choice that best meets your needs. Otherwise, you will probably not be happy. And if you are not happy with your professional life, then you probably will not be happy with your personal life either.

## DEALING WITH A JOB REJECTION

While a job rejection can be a shattering experience, it should also be taken as a learning experience. Following are some questions to ask yourself to help you identify areas for improvement.

- Were you late for the interview?
- Did you exhibit the appropriate attitude (positive, courteous, polite)?
- Were you truly qualified for the job? If so, you should analyze your job application and interview skills.
- Were you nervous or unprepared for the interview?
- Did your résumé include too much detail and not highlight those experiences that were pertinent to the job? Was it filled with typos and grammatical errors?
- Did you dress inappropriately or slouch through the interview?
- Did you have poor eye contact with the interviewer?
- Did you give short "yes" or "no" answers or mumble when giving the answers?
- Did you chew gum during the interview?
- Did you neglect to follow-up after the interview?
- Where could you have done better?

Use the knowledge you learn to do better when applying for the next job.

5. **Retain a job after being hired.**

Now that you have reviewed points 1 through 4 you will probably agree that it takes a lot of work to prepare yourself to enter the job market. So, when you succeed in getting the right job, it only makes sense that you will want to keep it. To help you get started on the job, here are some ways to keep your employer satisfied with your job performance.

- Be conscientious
- Avoid absenteeism
- Be punctual and ready to work
- Learn agency policies/procedures
- Be cooperative and maintain a positive attitude
- Be an effective team member
- Seek continuing education opportunities
- Offer suggestions and solutions
- Volunteer to serve on committees

When you begin your employment, you will probably have an opportunity to attend an employee orientation meeting. The benefits of participating in this activity include the following:

- Allows the employee to identify with the operation, its history, goals, and services
- Allows the employee to tour the facility and become familiar with his/her surroundings
- Gives the employee an opportunity to meet key personnel
- Provides information concerning the facility's policies and procedures, such as professional image and expected behavior
- Provides information concerning pay periods and benefits
- Ensures that the employee understands what is expected on the job
- Ensures that the employee understands how his other job fits in the overall operation
- Helps the employee feel comfortable with co-workers and in the work environment and therefore enables the employee to become more productive sooner

**OBJECTIVE 17**

# Assignment Sheet 1—Draw an Organizational Chart of the OR Suite for a Typical Hospital

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Chart was accurate for local medical facility | ______ |
| • Chart was neat and legible | ______ |
| • Directions were followed | ______ |
| **Overall rating** | ______ |

Evaluator's comments ____________________________________________

____________________________________________

____________________________________________

**INTRODUCTION**

It is important for you as a surgical technologist to understand your relationship to other individuals and departments in the medical facility. The organizational chart of the OR suite illustrates the direct and associated lines of authority within the surgical services department.

**EXERCISE**

**DIRECTIONS**

Obtain an organizational chart of an OR suite from the local hospital or medical facility where you will be working as a surgical technologist or obtain one from your instructor. Then draw an organizational chart of the OR suite based on the example you obtained.

**OBJECTIVE 18**

## Assignment Sheet 2—Distinguish Among Duties of the Surgical Team Members

Name ______________________________ Date ______________

---

**Evaluation criterion** **Rating**

- Answers are correct ______

**Overall rating** ______

Evaluator's comments ______________________________

---

**INTRODUCTION**

When working as part of a team, it is important to understand the role each team member plays. After completing this assignment, you should have a clear understanding of the duties each surgical team member performs in the surgical environment.

**DIRECTIONS**

Distinguish among the duties of the surgical team members by placing the following letters next to their correct descriptions. Some duties may be performed by more than one team member.

S = Surgeon
C = Circulator
A = Anesthesia provider
SP = Scrub Person

**EXERCISE**

______ 1. Assists anesthesia provider when needed

______ 2. Anticipates the needs of the sterile team

______ 3. Completes operative records

______ 4. Assists surgeon when needed by retracting tissue, cutting sutures, sponging and suctioning blood from the wound, or irrigating the wound

______ 5. Is ultimately responsible for the care of specimens received from the scrub

______ 6. May decontaminate and resterilize instruments and supplies

______ 7. Performs the surgery

______ 8. Performs the scrub prep and possibly shave prep of the patient

_______ 9. Anticipates the surgeon's needs by watching the progress of the surgery

_______ 10. Obtains and prepares all medications as needed during the procedure and obtains blood products for transfusion as directed

_______ 11. Assists in transporting patients before and after surgery

_______ 12. Identifies and cares for specimens received during surgery in prescribed manner, and passes to circulator

_______ 13. Primarily administers anesthetic agents

_______ 14. Provides preoperative education to patient

_______ 15. Identifies patient, and performs preoperative assessment

_______ 16. Tapes postoperative dressing

_______ 17. Assists with application of dressing

_______ 18. May accompany patient to Postanesthesia Recovery Room to give a nursing report of patient's progress, condition, and special equipment requirements

_______ 19. Cleans OR, and obtains furniture and equipment

_______ 20. Puts on sterile gown and gloves

_______ 21. Gowns and gloves the surgeon and assistants as soon as they enter the room

_______ 22. Assists in draping the patient with sterile drapes

_______ 23. Passes sterile instruments, supplies, and equipment to surgeon

_______ 24. Obtains and prepares all medications as needed during the procedure

_______ 25. Performs proper clean up of equipment and supplies

_______ 26. Performs surgical hand wash

_______ 27. Maintains equipment in operating condition, and sends for repairs as needed

_______ 28. Checks and connects electrical equipment to power sources, and connects suction to vacuum; handles nonsterile ends of equipment

_______ 29. Completes and maintains accurate operative records, including notation of any irregularities and incidents

_______ 30. Monitors patient vital signs in local or regional anesthetic cases

_______ 31. Obtains blood products for transfusion as directed

_______ 32. Maintains stock levels of supplies

_______ 33. After receiving medication onto the sterile field from the circulator, prepares and passes medications to surgeon

_______ 34. Observes for any breaks in aseptic technique

_______ 35. Prepares sterile field by assembling supplies and equipment

**OBJECTIVE 19**

# Assignment Sheet 3—Research Professional Health Care Associations and Their Magazines/Journals

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Web sites/journals referenced were listed | ______ |
| • Answers were complete and relevant to questions | ______ |
| • Work was neat and legible | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

______________________________________________

______________________________________________

**INTRODUCTION**

Just as AST is the professional organization for surgical technologists, other health care workers have their own societies and organizations that advance their profession. Some of the most notable you will want to familiarize yourself with include:

- American Academy of Physician Assistants (AAPA)
- American Association of Surgeon's Assistants (AASA)
- American College of Surgeons (ACS)
- American Hospital Association (AHA)
- American Medical Association (AMA)
- American Society of Anesthesiologists (ASA)
- Association of Perioperative Nurses (AORN)
- American Association of Nurse Anesthetists (AANA)

Membership in a professional organization is certainly not a guarantee that an individual is qualified for their profession, but in general it is a positive indicator and shows a level of commitment to their field of interest.

One common benefit of joining professional organizations is a subscription to their professional journal or magazine. Some health care journals should be available in your school's health resource center or at a hospital library, or may be available online at the organization's Web site. The publications listed on the following page can help you keep current with trends and advances in the clinical field.

- *The Surgical Technologist* (official journal of AST)
- *AORN Journal* (Association of Perioperative Nurses)
- *OR Manager*
- *Journal of Infection Control*
- *Journal of the American Medical Association*
- *Journal of the American College of Surgeons*

**DIRECTIONS** Research three professional organizations for health care workers and their professional journals/magazines to familiarize yourself with resources available in the health care field. Visit Web sites of professional health care organizations or interview a member of the association or organization you are researching. Check out or borrow copies of the three different professional journals you are reviewing if they are unavailable online. The Association of Surgical Technologists (AST) should be one of the three you research.

**EXERCISE**

1. Name of organization **The Association of Surgical Technologists**

   Title of organization's professional journal ______________________________

   ______________________________________________________________

   Source of information (Web site, individual, professional journal) ______________

   ______________________________________________________________

   Purpose (Mission) ____________________________________________

   ______________________________________________________________

   ______________________________________________________________

   Benefits of membership (List three.) ___________________________________

   ______________________________________________________________

   ______________________________________________________________

   What did you learn from the resource that will help you as a surgical technologist?

   ______________________________________________________________

   ______________________________________________________________

   ______________________________________________________________

   What articles or topics (at least three) did you find in the magazine/journal issue you reviewed? ________________________________________________

   ______________________________________________________________

   ______________________________________________________________

2. Name of organization ______________________________

Title of organization's professional journal ____________________

Source of information (Web site, individual, professional journal) __________

Purpose (Mission) ______________________________

Benefits of membership (List three.) ____________________

What did you learn from the resource that will help you as a surgical technologist?

What articles or topics (at least three) did you find in the magazine/journal issue you reviewed? ____________________

3. Name of organization ______________________________

Title of organization's professional journal ____________________

Source of information (Web site, individual, professional journal) __________

Purpose (Mission) ______________________________

Benefits of membership (List three.) ______________________________

______________________________

______________________________

What did you learn from the resource that will help you as a surgical technologist?

______________________________

______________________________

______________________________

What articles or topics (at least three) did you find in the magazine/journal issue you reviewed? ______________________________

______________________________

______________________________

OBJECTIVE 20

# Assignment Sheet 4—Research Organizations That Provide Health Care Support

Name ______________________ Date ____________

**Evaluation criteria** **Rating**

- Directions were followed ______
- Web sites referenced were listed ______
- Answers were complete and relevant to questions ______
- Work was neat and legible ______

**Overall rating** ______

Evaluator's comments ______________________________

INTRODUCTION

In addition to professional organizations such as AST, AORN, and the AMA, there are many governmental and private organizations that interact with individuals who work in the health care field. They range from groups such as the American Red Cross to governmental agencies such as the Department of Health and Human Services. Although their purposes and funding vary, they are all ultimately committed to improving both the health and well being of individuals and to the health care that we receive. Examples of governmental and private organizations include, but are not limited to the following:

**Governmental**

- Centers for Disease Control and Prevention (CDC)
- Department of Health and Human Services (HHS)
  - — Public Health Service (PHS)
  - — Health Care Financing Administration (HCFA)
  - — Social Security Administration (SSA)
- Environmental Protection Agency (EPA)
- Food and Drug Administration (FDA)
- Occupational Safety and Health Administration (OSHA)
- State and local health departments
- World Health Organization (WHO)

**Private**

- American Cancer Association
- American Diabetes Association
- American Heart Association
- American Red Cross

**EXERCISE**

**DIRECTIONS**

In this assignment, you will research two governmental agencies and two private organizations that impact health care services and provide support to the public. To complete this activity, you may go online at an organization's web site, or you may interview a representative of the agency/association you are writing about.

**Governmental Agencies**

1. Name of organization and its acronym ______________________________

______________________________________________

Source of information (Web site, individual, other) ____________________

______________________________________________

Purpose (Mission) ______________________________________

______________________________________________

______________________________________________

Available services ______________________________________

______________________________________________

Are there state and local offices for this organization/agency? ____________
If yes, list the address and phone number for the office nearest you.

Address ______________________________________________

State ________________________ Zip code ______________

Phone ________________________

What did you learn about the organization that will help you as a surgical technologist? ______________________________________

______________________________________________

______________________________________________

2. Name of organization and its acronym ______________________________

______________________________________________

Source of information (Web site, individual, other) ______________________

Purpose (Mission) ______________________

Available services ______________________

Are there state and local offices for this organization/agency? ____________

If yes, list the address and phone number for the office nearest you.

Address ______________________

State ______________ Zip code ____________

Phone ______________

What did you learn about the organization that will help you as a surgical technologist? ______________________

**Private Organizations/Associations**

1. Name of organization and its acronym ______________________

Source of information (Web site, individual, other) ______________________

Purpose (Mission) ______________________

Available services ______________________

Are there state and local offices for this organization/agency? ____________
If yes, list the address and phone number for the office nearest you.

Address ______________________

State ______________ Zip code ____________

Phone ______________________

What did you learn about the organization that will help you as a surgical technologist? ______________________

______________________

______________________

2. Name of organization and its acronym ______________________

______________________

Source of information (Web site, individual, other) ______________________

______________________

Purpose (Mission) ______________________

______________________

______________________

Available services ______________________

______________________

Are there state and local offices for this organization/agency? ______________________
If yes, list the address and phone number for the office nearest you.

Address ______________________

State ______________________ Zip code ______________________

Phone ______________________

What did you learn about the organization that will help you as a surgical technologist? ______________________

______________________

______________________

# Introduction to Surgical Technology

## SECTION A: Orientation to Surgical Technology

### Module 2-A: Interpersonal Relationships and Communication Skills

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# Introduction to Surgical Technology
## Section A: Orientation to Surgical Technology
## Module 2-A: Interpersonal Relationships and Communication Skills

**PREREQUISITES:**
**None**

### Learning Activities Sheet

Student name ________________________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 6.

☐ 5. **Research** Online resources to learn more about interpersonal relationships and communication skills. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________

☐ 6. **Do** Assignment Sheet 1, "Evaluate Your Interpersonal Relationship Skills."

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat step 6.

☐ 8. **Study** Information Sheet, Objective 7 through Objective 10.

☐ 9. **Do** Assignment Sheet 2, "Evaluate Your Listening Skills."

☐ 10. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 11. If the evaluation is not satisfactory, repeat step 9.

☐ 11. **Study** Information Sheet, Objective 11 and Objective 12.

☐ 12. **Read** Student Supplement 1, "Rules for Communicating on the Telephone," and Student Supplement 2, "Body Language."

☐ 13. **Do** Assignment Sheet 3, "Apply Effective Communication Skills in Given Situations."

☐ 14. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 15. If the evaluation is not satisfactory, repeat steps 11 and 13.

☐ 15. **Study** Information Sheet, Objective 13 through Objective 16.

☐ 16. **Do** Assignment Sheet 4, "Evaluate Therapeutic Communication Skills in Given Situations."

☐ 17. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 18. If the evaluation is not satisfactory, repeat steps 15 and 16.

☐ 18. **Take** Written Test provided by your instructor.

☐ 19. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 20. If the evaluation is not satisfactory, repeat steps 4, 8, 11, 15, and 18.

☐ 20. **Check** With your instructor for any additional assignments to be completed.

☐ 21. **Do** Additional assignments your instructor lists below.

______________________________________________

______________________________________________

______________________________________________

☐ 22. **Take** Module Review provided by your instructor.

☐ 23. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 24. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to apply effective interpersonal relationship and communication skills as they relate to surgical technology. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Distinguish among types of relationships.
2. Select factors needed for good relationships.
3. Arrange in order Maslow's hierarchy of human needs.
4. List the causes of stress in the operating room, the impact of stress on the body, and methods of coping with stress.
5. Select true statements concerning psychosocial stress in the patient and within the surgical team.
6. List goals of communication.
7. Match means of communication to their correct descriptions.
8. State the purposes of communication among hospital team members.
9. List essential components of effective communication.
10. List effective listening skills utilizing components of communication.
11. Describe effective speaking skills.
12. Identify means of communication that enable other hospital departments to relate to the surgical suite and assure continuity of patient care and safety.
13. Select true statements concerning the importance of effective communication for the patient undergoing surgery.
14. Match techniques for therapeutic communication to their correct examples.
15. Match blocks to therapeutic communication to their correct examples.
16. Select communication requirements of the surgical team during surgery.
17. Evaluate your interpersonal relationship skills. (Assignment Sheet 1)
18. Evaluate your listening skills. (Assignment Sheet 2)
19. Apply effective communication skills in given situations. (Assignment Sheet 3)
20. Evaluate therapeutic communication skills in given situations. (Assignment Sheet 4)

## Information Sheet

**OBJECTIVE 1** **Distinguish among types of relationships** (see Figure 1 on the next page).

✔ **NOTE:** We have some kind of relationship with each person we encounter. We behave and communicate differently whether we are with people we've just met, our most trusted friends, a spouse or "significant other," family members, bosses, co-workers, and so on. As a health care professional, you will have the daily responsibility for managing the special relationship you will form with your patients.

1. **Social**
   - Between **peers**
   - Mutual relationship (involves sharing, give-and-take)
   - NOT goal directed
   - May be casual or intimate, brief or long lasting
   - **Behavior** limited by social **protocol**, but feelings, ideas, and actions are expected to be shared and respected

KEY TERMS

**Peer**—One that belongs to the same group in society, primarily determined by age, grade, or status

**Behavior**—Observable response of an individual to the environment

**Protocol**—To adhere to the appropriate manners and behavior within a given situation

2. **Professional**
   - Between co-workers of a profession such as
     - Employee-employer
     - Surgical team
     - Surgical technologist and workers in other departments
   - NOT a mutual relationship
   - Goal directed
   - Limited to conduct under job description

- Behavior is guided by **ethical** code and policies of institution, along with common courtesy and good manners

✔ **NOTE:** Individuals having this type of relationship do NOT overstep their positions.

KEY TERM

**Ethical**—Adhering to accepted principles of right and wrong that govern the conduct of a profession

3. **Therapeutic**

- Between health care team members and the patient and the patient's family
- NOT a mutual relationship
- Goal directed
- Involves the care and treatment of the patient by the health care team
- Relationship lasts as long as needed to perform service to patient
- The patient's trust and **confidentiality** must be respected

KEY TERMS

**Therapeutic**—To help heal or improve one's health or well being

**Confidentiality**—Keeping information given to you in confidence secret of a profession

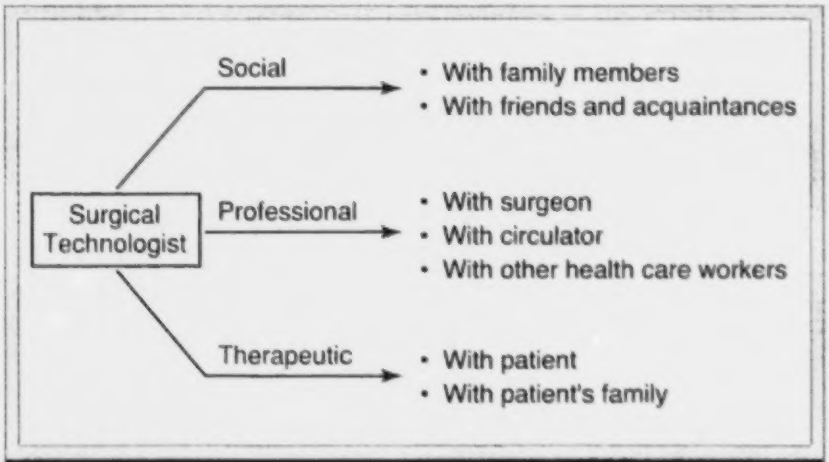
Surgical Technologist
Social
• With family members
• With friends and acquaintances
Professional
• With surgeon
• With circulator
• With other health care workers
Therapeutic
• With patient
• With patient's family

**Figure 1**
Types of relationships involving the surgical technologist

OBJECTIVE 2

**Select factors needed for good relationships.**

1. **Effective communication**
2. **Recognizing and meeting your needs**
3. **Recognizing and meeting other person's needs**
4. **Behaving in the correct manner at the correct times by**
   - Recognizing the type of relationship that exists
   - Reacting appropriately within the relationship

OBJECTIVE 3

**Arrange in order Maslow's hierarchy of human needs** (see Figure 2 on the next page).

✔ **NOTE:** Psychologist Abraham Maslow identified the following as **needs** common to all. Based on a **hierarchy** of priority, the lower (more basic) needs must be met before an individual can move to the next level. These needs are stated below from lowest to highest.

KEY TERMS

**Need**—Physiological or psychological requirement for the well-being of an organism

**Hierarchy**—People or things organized or classified by rank

1. **Physiological**—Most basic and dominant; includes need for food, fluid, oxygen, temperature regulation, physical activity, rest, elimination, and sexual satisfaction
2. **Security**—Includes feeling safe, emotionally secure, and comfortable
3. **Social**—Includes affection, love, acceptance, kindness, belonging, intimacy, and friendship
4. **Ego**—Includes approval, recognition, prestige, and status from others because of an individual's actions; elevates **self-esteem**, confidence, and **self-image**

KEY TERMS

**Self-esteem**—Confidence and satisfaction in oneself

**Self-image**—Mental concept one has of oneself

5. **Self-actualization**—The ultimate in personal achievement; achievement in reaching goals of direction, identity, realization, and fulfillment

   ✔ **NOTE:** In some individuals the need for self-actualization may never be satisfied, or it may be satisfied only for brief "quality" moments.

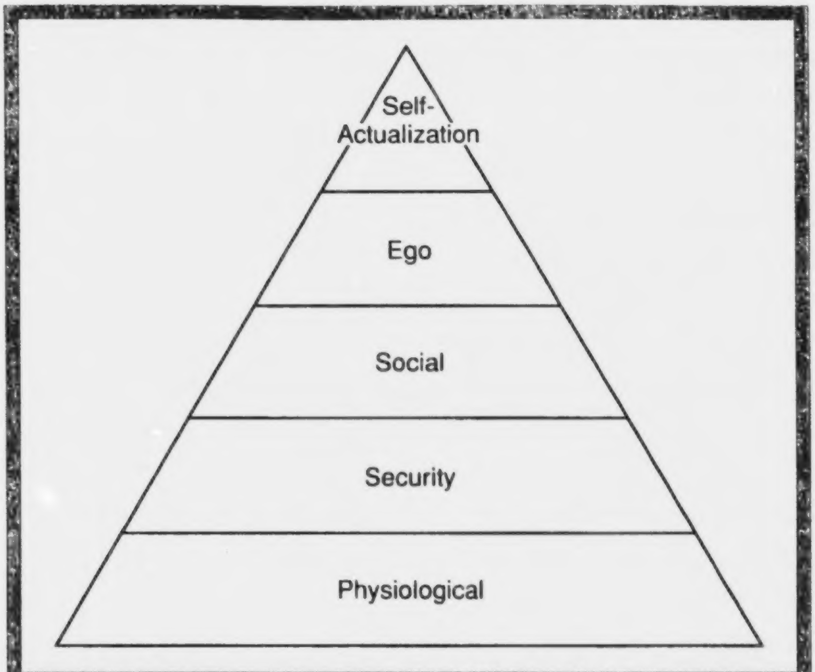

**Figure 2**
Maslow's hierarchy of human needs

✔ **NOTE:** In the health care environment, the primary concern is correction of physiological needs. However, the surgical team can contribute to the healing of the total person by being considerate and respectful of the patient's higher needs.

OBJECTIVE 4

**List causes of stress in the operating room, the impact of stress on the body, and methods of coping with stress.**

1. **Stress**—A state of extreme difficulty, pressure, or strain that can cause bodily or mental tension. While some amount of stress makes adrenaline flow when you need it, in general it has a negative impact on one's well-being.

2. **Stressor**—An agent, condition, or other stimulus that causes us stress. Generally speaking, they are the physical and psychological demands that are placed upon us by our job, our family, creditors, other humans, major life events, our environment, habits, and activities. In the operating room, stressors can include:

   - General surgical environment (sound, smell, sights)
   - Team member personalities
   - Emergency situations
   - Unfamiliar procedures
   - Malfunctioning equipment

- Incorrect or insufficient supplies and tools
- Breach in aseptic technique
- Situations involving moral, ethical, and legal dilemmas or challenges

3. **The physical wear and tear that stress causes include:**

   - High blood pressure
   - Headache
   - Loss of appetite
   - Increased appetite
   - Weakened immune system
   - Heart failure

4. **We physically react to stressors by increased heart and pulse rates, tense muscles, and upset stomach. We need to recognize stressors and learn to manage stress properly. Some coping methods to positively deal with stress include:**

   - Exercising
   - Imagery
   - Deep breathing
   - Muscle relaxation
   - Getting enough sleep
   - Humor
   - Positive reflection on your day's events
   - Eating healthy, regular meals
   - Caring for your physical and emotional needs
   - Professionally, yet assertively dealing with sources of conflict

✔ **NOTE:** Since you are obviously limited to the stress reduction techniques you can actually use in the operating room, you should use them outside whenever possible.

OBJECTIVE 5

**Select true statements concerning psychosocial stress in the patient and within the surgical team.**

✔ **NOTE:** Surgery is stressful for both the patient and the surgical team. The patient has natural fears about whether they will live or die, their quality of life after surgery, how their family will cope, and perhaps even how they will pay for the surgery. Surgical team members are expected to perform complicated procedures under trying conditions and never make mistakes. Although the surgical technologist has limited communication with the patient, if he/she notices stress factors that other members of the team are not aware of, this should be discreetly communicated to the circulator.

1. **Patients react to their fears and anxiety in many different ways, including the following:**
   - Resentment or hatred toward the health care team
   - Changes from normal speaking patterns (increased verbalization, reduced verbalization, increased speech rate, voice tremors, etc.)
   - Physical changes (muscular tension, trembling hands, increased heart and respiratory rate, etc.)
2. **Stress may be especially acute among children as they**
   - Lack the understanding of the complex surgical environment
   - Are afraid of injections and pain
   - Have a strong fear of anesthesia
   - Can experience overwhelming separation anxiety
3. **An elderly patient can experience disorientation, confusion, and depression, and may require extra care and patience.**
4. **Members of the surgical team should look for these signs and act within their capabilities to calm the patient. Appropriate responses depend upon the situation, but may include:**
   - Allowing the patient to verbalize and explore their fears and grief
   - Frank, simple discussion of the surgical technique
   - Helping the patient with deep breathing or other relaxation techniques
   - A simple comforting touch
   - Maintaining a quiet, unhurried surgical environment
   - Identification of the patient's requirements for physical comfort such as the need for a blanket
   - Discussions with members of the patient's family or other support team

5. **Among the surgical team, stress is an inherent part of the job. It can become strongest when working with new personnel, heavy workloads, or crisis situations.**

6. **Harsh criticism directed at a member of the surgical team may be a surgeon's method of coping with particularly difficult situations and should not be taken personally. However, if a member of the surgical team has not performed their part of the procedure as effectively as possible, the problem cited by the surgeon should not be ignored.**

   ✔ **NOTE:** See this as an opportunity to learn from your mistakes and to better prepare yourself for the next procedure.

OBJECTIVE 6 **List goals of communication.**

1. **To give information to others**
2. **To obtain information from others**
3. **To express feelings**
4. **To solve problems through communication**
5. **To persuade others to change an attitude or behavior**

KEY TERM

**Communication**—Process by which information is exchanged between individuals through a common system of words, symbols, signs, or behavior

OBJECTIVE 7 **Match means of communication to their correct descriptions.**

1. **Verbal**—Communication using words
   - **Oral**—Words are spoken aloud; depends on the abilities to speak and hear

     Example: Conversations, speeches, telephone messages

   - **Written**—Words are written; depends on the abilities to write, read, and see

     Examples: Books, letters, fax messages, electronic mail, patient records, order forms

2. **Nonverbal**—Communication sent in ways other than by words; depends on the five basic senses

   Examples: Body language, medical symbols, crying, moaning, colors, smells, tastes, feelings of hot or cold, art, bar codes to be read by computers

OBJECTIVE 8 **State the purposes of communication among hospital team members.**

1. **To maintain accurate records**
2. **To promote employee relations within the surgical team and between the surgical team and other hospital departments**

   ✔ **NOTE:** Communication among hospital departments is extremely important. At a simple level, miscommunication among departments could mean the wrong supplies get sent or inconveniences such as scheduling problems, while at a critical level miscommunication could mean that the patient receives the incorrect procedure or follow-up treatment or physical therapy.

3. **To promote teamwork within the surgical environment**

   ✔ **NOTE:** In the operating room, surgical team members keep verbal communication to a minimum in order to concentrate on the procedure as well as to hear audible equipment signals. Therefore, the scrub needs to be able to identify the surgeon's needs by reading eye motions and hand gestures. Misinterpreting signals can lead to mistakes, frustration, and a possible delay in the procedure.

4. **To provide continuity of patient care as efficiently and cost-effectively as possible**
5. **To identify patient needs**

   ✔ **NOTE:** The health care team identifies patient needs by talking with the patient, observing any nonverbal signals, and observing the patient's behavior.

6. **To ensure that legal aspects are considered**

   ✔ **NOTE:** A patient's chart is a legal document and all information entered must be accurate (objective and factual), well organized, and clearly written to ensure proper continuity of care. Miscommunication causing inaccurate information to be recorded on a patient's chart can lead to a lawsuit.

OBJECTIVE 9 **List the essential components of effective communication** (see Figure 3 on the next page).

1. **Sender**—Person sending a message
2. **Message**—The information being transmitted

   ✔ **NOTE:** The way in which a message is conveyed to the receiver is called the medium, which may be verbal or nonverbal.

3. **Receiver**—Person to whom the message is directed
4. **Feedback**—Evaluation returned by the receiver of the message to the sender of the message

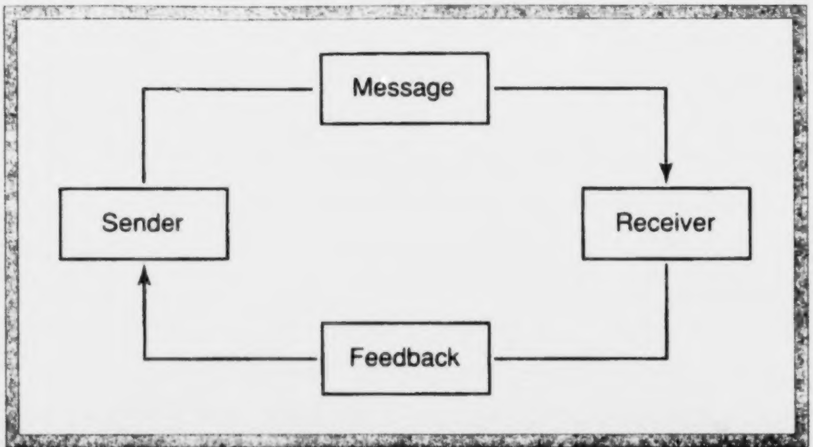

Figure 3
Components of effective communication

**OBJECTIVE 10** **List effective listening skills utilizing components of communication.**

✔ **NOTE:** An effective listener is quiet and focuses on the speaker. Surgical technologists, especially in the circulator role, are often busy doing several things at once. If you do not show patients that you will take time to listen to them, they may feel that you are too busy to be bothered with their concerns.

1. **Defer judgment.**

   ✔ **NOTE:** Sometimes it is hard to stop talking long enough to hear others speak, especially if you don't agree with them. If what they say provokes an emotional response in you, it is very hard not to respond immediately. But to listen effectively, you cannot be talking or formulating your next response.

   - Listen with an open mind to what the speaker has to say.
   - Do not draw hasty conclusions or make assumptions.

2. **Listen for the whole message.**

   - Listen to verbal messages and observe nonverbal messages.
   - Listen for ideas, feelings, and intentions as well as facts.

     ✔ **NOTE:** This includes hearing things that are unpleasant or unwelcome.

3. **Pay attention.**

   - Block out visual and auditory distractions.
   - Focus on the message, not the speaker.
   - Use nonverbal feedback (eye contact, head nods, smiles) to let the speaker know that he or she is being understood.

4. **Listen completely.**

   - Avoid letting your mind wander while you pretend to listen.
   - Avoid interrupting and talking.
   - Avoid mentally rehearsing responses.

5. **Paraphrase what was heard.**

   - When the speaker is finished, repeat in your own words what the speaker said, and ask if that is what was meant.
   - If the message is long and complex, jot down brief notes, and refer to them when paraphrasing or performing a task.

✔ **NOTE:** To be an effective listener you must not only hear what is said, but also what is not said or what is implied. This could be called "listening between the lines." This is especially important when communicating with patients. Many times they may be afraid to state their concerns, so they may only give you hints about what is on their mind.

Example: The patient says "I can never understand what my doctor is saying when he talks to me about my cancer." The health care professional who "listens between the lines" also hears, "I need someone to explain this better."

OBJECTIVE 11

**Describe effective speaking skills.**

1. **Assess**—Determine purpose and audience.
2. **Plan**—Determine what to say and how.
3. **Present**—Be sincere. Be aware of voice tone, fluency, articulation, and nonverbal communications.
4. **Listen**—Listen to feedback and look for nonverbal cues from the audience.
5. **Evaluate**—Use feedback to see if the correct message was received.

OBJECTIVE 12

**Identify means of communication that enable other hospital departments to relate to the surgical suite and assure continuity of patient care and safety.**

1. **Records**

Examples: Count records, charges, incident reports, patient records, operative records, treatment plans, anesthesia records, pathological reports, laboratory forms, informed consent records, etc.

✔ **NOTE:** Information on patient records is legal documentation and must be accurate. Using white-out or erasures is not allowed.

2. **Requisitions**

   Examples: Supply requests, doctor's preference cards or procedure cards

3. **Inservice programs**

   Example: Monthly inservice programs that allow departments to communicate standards or proper policy

4. **Computers**

   Examples: Electronic record keeping and e-mail

5. **Verbal**

   Examples: Post-operative instructions, notes about patient's condition, comments about the surgery, verbal request for supplies which will be needed for a procedure

OBJECTIVE 13

**Select true statements concerning the importance of effective communication for the patient undergoing surgery.**

✔ **NOTE:** Cultural and ethnic factors need to be considered when communicating with patients. Different belief systems have varying standards of acceptability regarding eye contact, physical space between communicators, the meaning of what is and is not said, appropriateness of conversation between persons of the opposite sex, and other psychological and social considerations.

1. **Communication is the basis for the continuum of patient care and teamwork among the staff.**
2. **Patients under the stress and anxiety of the upcoming surgery have a deep need to communicate their feelings or their emotional and physical needs to the health care team.**
3. **Patients indicate their needs by what they say (verbal) and by what they do not say (nonverbal). The surgical team must listen and observe for both types of communication.**
4. **Effective communication can influence:**
   - The patient's behavior while in the operating room suite, and in the hospital later.
   - The patient's attitude toward surgery and health care workers.

OBJECTIVE 14

**Match techniques for therapeutic communication to their examples.**

1. **Using broad opening statements**

   Examples: "Is there something bothering you?" "Is there something you'd like to talk about?"

2. **Using general leads**

   Examples: "Yes...Oh?...Go on...I see."

3. **Giving information to the patient**

   Examples: "My name is Mary Jones. I'm taking you to the operating room where your surgery is scheduled."

4. **Sharing observations with the patient**

   Examples: "You're trembling. You seem upset. Am I wrong?"

   ✔ **NOTE:** By sharing observations, the patient has the opportunity to verify, correct, or elaborate the observation. This encourages the patient to communicate, and prevents you from assuming the meaning behind the patient's behavior. In the above example, the patient may have simply been cold.

5. **Acknowledging the patient's feelings**

   Example: Patient: "I hate wating here."
   Care giver: "Yes, it must be frustrating for you."

6. **Reflecting (paraphrasing) to encourage the patient to go on**

   ✔ **NOTE:** This can be very effective, but it can also be overused.

   Example: Patient: "I hate waiting here. I'm so frustrated."
   Care giver: "You are frustrated with waiting."

7. **Selective reflecting (one part of the patient's statement is repeated or rephrased to encourage further exploration of that part)**

   Example: Patient: "I'm tired, and I don't like it here."
   Care giver: "You're tired?"

8. **Using silence to allow patient to collect his/her thoughts**

   Example: Patient: "I, well, I just don't, well..."
   Care giver: ...

9. **Clarifying to avoid misunderstanding**

   Example: Care giver: "I'm not sure I understand. Are you saying that..."

10. **Validating to make sure the patient's needs have been met**

    Example: Care giver: Covers patient, then asks, "Are you warmer now?"
    Patient: "Yes."
    Care giver: "Is there anything else you need?"
    Patient: "No, I'm fine now."

OBJECTIVE 15

**Match blocks to therapeutic communication to their examples.**

1. **Using clichés**

   - Reduces your anxiety (when you don't know what to say) rather than reducing the patient's anxiety
   - Blocks communications because these clichés minimize the significance of the patient's feelings, or tell the patient that you're not interested

   Examples: "Everything will be okay." "You don't need to worry."

KEY TERM

**Cliché** (kle-sha´)—Expression or idea that is overused

2. **Giving advice**—Imposes your opinions and solutions on patients rather than having them explore for their own solution

   Example: "What you should do is..."

3. **Giving approval or agreement**—Shifts the focus of the discussion to your values or feelings

   Examples: "Yes, that's good." "I agree with you."

4. **Requesting an explanation**—"Why" questions can be intimidating because patient is asked to immediately analyze and explain their feelings or actions

   Example: "Why are you doing (or saying) that?"

5. **Belittling the patient's feelings**—Makes the patient feel that his/her feelings are not important or unique, and that the patient is not unique; shifts the conversation away from the patient which blocks communication

   Example: Patient: "I wish I were dead."
   Care giver: "I know just how you feel. Everyone feels that way."

6. **Expressing disapproval or disagreement with the patient**—Shifts the focus of the discussion to your values and feelings, and can cause anger, intimidation, defensiveness, and withdrawal in patient

   Example: "That's not good." "You're wrong."

7. **Defending**—Tells patient they have no right to express negative comments or opinions

   Example: Patient: "I don't like this old hospital."
   Care giver: "This is NOT an old hospital. We have the most up-to-date equipment that you could find anywhere in this state."

8. **Changing the subject**—Takes the lead away from the patient, and focuses conversation on what you want to talk about rather than what they wanted to talk about (which may have been making you uncomfortable)

   Example: Patient: "I wish I could just die."
   Care giver: "How did you sleep last night?"

OBJECTIVE 16

**Select communication requirements of the surgical team during surgery.**

1. **Listen carefully and speak clearly. More effort is required for good communication because of the operating room masks.**
2. **Communicate professionally by understanding and using correct medical and operating room terminology.**
3. **Communicate therapeutically with patients and their families.**
4. **Follow verbal (oral and written) directions quickly and correctly.**
5. **Respond to and use nonverbal communication techniques as needed in surgery.**

   ✔ **NOTE:** Nonverbal communication helps in surgery to cut down on talking which can be distracting to members of the surgical team and may be upsetting to the patient. Signals and gestures can also be faster than verbal explanations of what is needed.

## Student Supplement 1—Rules for Communicating on the Telephone

Telephones are commonly used in the surgical suite for requesting information or supplies and for receiving information about patients. The surgical technologist must respond to numerous telephone inquiries and relay accurate messages. They receive and record telephone reports from other departments and must relay information to the nurse in charge or other appropriate personnel.

The following are rules for communicating on the telephone.

- Be courteous.
- Speak clearly and distinctly.
- Speak directly into the receiver, which should be held about 1 inch from your mouth.
- Ask other person to speak more loudly or repeat information if you cannot hear well.
- Identify yourself.

  ✓ **NOTE:** This is important both when you are placing and receiving calls.
- Identify other party if they did not identify themselves.
- Record all information clearly and accurately.
- Make a note of the time of the call.
- Verify all information that you have recorded. Repeat what you have written.
- Only licensed personnel can record doctor's orders.

## Student Supplement 2—Body Language

Body language (gestures, facial expressions, and posture), as well as voice inflections and tone, provide clues to one's feelings and attitudes, and will either reinforce or contradict what is said verbally. Since studies have shown that nonverbal communication has a higher validity than verbal communication, it is important to watch for and recognize what people are communicating through their nonverbal signals.

**Table 1** Positive Gestures, Expressions, and Stances

| Nonverbal Signals | Feelings and Attitudes |
|---|---|
| Eye contact | Attentive, listening |
| Smiling | Agreement, pleasure, humor |
| Open stance (arms unfolded, legs uncrossed) | Friendly, receptive, not defensive |
| Hand stroking chin | Thoughtful consideration |
| Hand on cheek | Thinking, interested, attentive |
| Sitting with feet flat on floor | Poised |
| Sitting slightly forward in chair | Attentive |
| Leaning slightly forward toward person | Attentive, involved |
| Head nodding up and down | Agreement, support |

**Table 2** Negative Gestures, Expressions, and Stances

| Nonverbal Signals | Feelings and Attitudes |
|---|---|
| Tapping fingers, cracking knuckles, wringing hands, tugging hair | Lack of confidence, uneasiness, boredom, nervousness |
| Moving around in chair | Restlessness |
| Clenched fists | Hostility, lack of acceptance |
| Arms folded tightly high on chest | Closed, defensive, disagreement, discomfort, withdrawing from conversation |
| Side of head leaning on hand | Boredom or tiredness |
| Raised eyebrows | Surprise, doubt, indifference |
| Scowl or frown | Disapproval |
| Lips pressed tightly | Anger, determination |
| Turning head from side to side | Disagreement |

✔ **NOTE:** In our culture, direct eye contact communicates the message that you are listening and interested in the other person. However, in some cultures, direct eye contact is a signal of disrespect and challenge of authority. Be aware that some patients may not make direct eye contact with health care workers who may be seen as persons of authority.

**OBJECTIVE 17**

## Assignment Sheet 1—Evaluate Your Interpersonal Relationship Skills

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Directions were followed ______
- Questions were answered honestly ______
- Suggestions for improvement were appropriate ______
- Correct grammar, punctuation, and spelling were used ______

**Overall rating** ______

Evaluator's comments ________________________________________

________________________________________________________

________________________________________________________

**INTRODUCTION**

Your interpersonal relationships can provide support during times of stress and can help you learn and grow as a surgical technologist.

**EXERCISE**

**DIRECTIONS**

Answer the following questions by circling "Yes" or "No." Then answer the statements by describing ways you can improve your interpersonal relationships.

Social Relationships

Yes No 1. I make friends easily with males.

Yes No 2. I make friends easily with females.

Yes No 3. I have several close friends.

Yes No 4. I feel close to several family members.

Yes No 5. I can express my feelings and ideas without worrying about what my friends will think.

Yes No 6. I am not afraid to ask for help when I need it or ask questions when I don't understand.

Yes No 7. I can give and accept compliments.

Yes No 8. When working in a group, I can accept other people's ideas and suggestions.

Yes No 9. I spend most of my free time with friends or family.

Yes No 10. I have someone that I can talk to about personal problems.

Professional Relationships

Yes No 1. I understand and follow the code of ethics for medical professionals.

Yes No 2. I understand and follow the policies and procedures of the medical institution where I work/train.

Yes No 3. I feel that I am an important member of the health care team.

Yes No 4. I use constructive criticism from my superiors to improve my performance on the job.

Yes No 5. I can express my opinions about work situations without feeling intimidated by co-workers.

Yes No 6. I am comfortable with the current stress level at work.

Yes No 7. I have someone at work that I can talk to about job problems.

Yes No 8. I avoid gossiping about people.

Yes No 9. I am comfortable carrying on a conversation with a superior.

Yes No 10. I am not afraid to ask for help when I need it or ask questions when I don't understand.

Therapeutic Relationships

✔ **NOTE:** Disregard this section if you have not worked with patients or families.

Yes No 1. I understand and follow the code of ethics for medical professionals.

Yes No 2. I understand and follow the policies and procedures of the medical institution where I work/train.

Yes No 3. I feel comfortable talking to patients.

Yes No 4. I feel comfortable talking to patients' families.

Yes No 5. I keep in mind the patient's needs as I work with them.

Yes No 6. I give my best effort when working with patients.

Yes No 7. I understand my responsibility to the patient.

Yes No 8. I respect the patient's rights.

Yes No 9. I enjoy working with patients.

Yes No 10. I can cope with disappointment and success.

Suggestions for Improvement

1. One way that I could improve my social relationships is to ____________________

2. One way that I could improve my professional relationships is to ____________________

3. One way that I could improve my therapeutic relationships is to ____________________

**OBJECTIVE 18**

## Assignment Sheet 2—Evaluate Your Listening Skills

Name ______________________ Date __________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Evaluation was scored correctly | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________

________________________________________________

________________________________________________

**INTRODUCTION**

A good listener must participate in the communication process. As a surgical technologist you will be expected to listen to all members of the surgical team, the patient, and many other employees in the medical facility. When lives are at stake, good listening skills are vital. This assignment will give you the chance to identify poor listening skills so you can change them.

**EXERCISE**

**DIRECTIONS**

Answer the survey questions on the next page by placing a checkmark in the appropriate box under "Often," "Sometimes," or "Seldom." Then, total your score. Analyze your score by referring to the listening analysis located at the end of this assignment sheet.

LISTENING SURVEY

| | Often | Sometimes | Seldom |
|---|---|---|---|
| 1. It is said that you think four times faster than the person talking to you. Do you use this excess time to turn your thoughts elsewhere while you keep general track of the conversation? | | | |
| 2. Do you listen primarily for the facts rather than for the ideas? | | | |
| 3. When you hear certain words, phrases, or ideas that you do not like, do you quit listening? | | | |
| 4. When you are confused or irritated by what is being said, do you try to straighten out the matter immediately-either in your own mind or by interrupting the speaker? | | | |
| 5. If you feel it would take too much time or effort to understand something, do you go out of your way to avoid hearing about it? | | | |
| 6. Do you deliberately turn your thoughts to other subjects when you think that the speaker has nothing interesting to say? | | | |
| 7. Can you judge by a person's appearance and manner of speech that he/she will have nothing important to say? | | | |
| 8. Do you try to give a person the impression that you are listening when you are not? | | | |
| 9. Are you easily distracted by movements, sounds, or outside activities when you are listening to someone? | | | |
| 10. Do you record detailed notes of everything said if you only want to remember the main ideas? | | | |
| TOTAL | | | |

LISTENING ANALYSIS

If you scored four or more in the "Often" column, you have poor listening habits. Look at the questions you checked "Often." What poor listening habits do they describe? The first step to good listening is to recognize your poor listening habits. Then you must work to improve your listening skills.

If you scored seven or more in the "Sometimes" column, you are generally a good listener, but you need to practice some to improve your listening skills.

If you scored seven or more in the "Seldom" column, you are generally an excellent listener. To become an even better listener, work on those three or four areas where you checked "Sometimes" or "Often."

**OBJECTIVE 19**

## Assignment Sheet 3—Apply Effective Communication Skills in Given Situations

Name ______________________ Date ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, punctuation, and spelling were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

______________________________

______________________________

**INTRODUCTION** Effective communication skills are the foundation for teamwork and patient care. This assignment will provide practice in the application of effective communication skills.

**EXERCISE**

**DIRECTIONS** Read each situation presented in this assignment and then answer the questions that follow each situation.

**SITUATION 1** You are given the assignment of presenting the rationale and technique of open gloving to the class.

a. According to the goals of communication, what is the purpose of your presentation?

______________________________

______________________________

______________________________

b. Under the planning phase of preparing your presentation, briefly describe how you are planning to communicate the technique of open gloving to the class.

c. List three things to remember when presenting to the class.

- 
- 
-

d. Briefly describe how you plan to incorporate nonverbal communication into your presentation.

e. Describe how you will encourage feedback from your classmates.

f. How will you know if your presentation has been effective?

**SITUATION 2** As a staff surgical technologist you are assigned the responsibility of working with three surgeons who have been trying to decide on the purchase of a new piece of equipment. The surgeons have been unable to decide on exactly which piece of equipment to purchase from which company.

a. According to the goals of communication, what is the major goal of your assigned task?

b. You have planned your presentation and have set up the time and place to meet with the three surgeons. As you enter the room, one doctor is sitting in the corner of the room with his legs crossed and his arms folded across his chest. The other two doctors are visiting and smiling.

- Briefly describe any positive nonverbal communications that are occurring.

- Briefly describe any negative nonverbal communications that are occurring.

c. Briefly describe two nonverbal communications that you will avoid in your presentation.

-
-

**OBJECTIVE 20**

## Assignment Sheet 4—Evaluate Therapeutic Communication Skills in Given Situations

Name ______________________ Date ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, punctuation, and spelling were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

______________________________

______________________________

**INTRODUCTION** As a surgical technologist, it is important that you are able to identify factors that influence communications and utilize appropriate communication tools to ensure quality care for individual patients.

**EXERCISE**

**DIRECTIONS** Read each situation presented in this assignment and then answer the questions that follow each situation.

**SITUATION 1** A 43-year-old female is scheduled to have a breast biopsy and possible mastectomy.

a. Briefly describe one influencing factor that must be considered when interacting with the patient.

______________________________

______________________________

______________________________

b. Based upon the factor that you identified above, briefly describe a therapeutic communication tool that would be useful.

**SITUATION 2** You are assigned to transport a patient to the operating room. During this time the patient states that he is concerned about his son who was to get up on his own and get to the school bus.

a. What level of needs does this example describe on Maslow's triangle?

b. Briefly describe one therapeutic communication tool that would be appropriate in this situation.

**SITUATION 3** As you walk into the preoperative waiting area, you notice a patient who is shaking. Describe what action you would take to assess the patient's needs.

**SITUATION 4** A patient who is having surgery under general anesthesia is at what level of Maslow's triangle?

**SITUATION 5**

You are asked to go to the preoperative waiting area to let a patient know that there has been a delay and that the circulating nurse will be bringing him to the operating room in about fifteen minutes. You are aware of the following patient information: He is a 16-year-old male who was diagnosed with AIDS two years ago; he is a hemophiliac; he requires surgical removal of a malignant tumor in the large intestine; and his father is waiting with him.

Identify the following examples as appropriate or not appropriate interactions by circling "A" for appropriate or "NA" for not appropriate. Give a brief rationale for each answer.

A NA a. You start your conversation by addressing the patient's father and say, "The nurse will be here in about 15 minutes."

Rationale ______________________________

______________________________

______________________________

A NA b. You address the patient by introducing yourself and calling the patient by his name.

Rationale ______________________________

______________________________

______________________________

A NA c. The patient angrily says, "I know why no one wants to help me. They are afraid they'll get AIDS!" You respond, "Well, if you will just listen to me. The surgeon had to go to the emergency room. You can trust us. We are professionals. Don't worry. Everything is going to be OK."

Rationale ______________________________

______________________________

______________________________

A NA d. The father asks you to stay with his son while he goes to talk with the other family members. You stay and ask the patient if there is anything you can do to make him more comfortable. You sit in the chair next to the patient.

Rationale ______________________________

______________________________

______________________________

A NA e. The patient says that he is fine, but you notice that he is shaking. You say, "Why are you shaking?"

Rationale ______________________________

______________________________

______________________________

**SITUATION 6** A 4-year old female patient is waiting with her mother in the preoperative waiting room. The child is clinging to her mother. Describe two factors that will influence the care givers' interactions with the child and mother.

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______________________________

For Situations 7 through 9, read each of the following examples and decide if they are appropriate when considering a patient's cultural/ethnic needs. If the example given is appropriate, circle the A. If it is not appropriate, circle the NA. Following each example give a brief rationale.

**SITUATION 7** An interpreter is used for communications prior to taking a patient to surgery and stays until the patient is asleep.

A NA Rationale ______________________________

______________________________

______________________________

**SITUATION 8** A patient is allowed to take a religious symbol with him into surgery.

A NA Rationale ______________________________

______________________________

______________________________

**SITUATION 9** A care giver feels that by asking if the patient has any questions he/she had adequately assessed the patient's understanding and need for information.

A NA Rationale ______________________________

______________________________

______________________________

**SITUATION 10**

During a surgical procedure the surgeon accuses the surgical technologist of poor work and says that she might as well leave. Describe an appropriate way to deal with this comment.

# Introduction to Surgical Technology

## SECTION A:
## Orientation to Surgical Technology

### Module 3-A: Legal and Ethical Responsibilities

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# Introduction to Surgical Technology
## Section A: Orientation to Surgical Technology
## Module 3-A: Legal and Ethical Responsibilities

**PREREQUISITES:**
**None**

### Learning Activities Sheet

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 5.

☐ 5. **Read** Student Supplement 1, "The Association of Surgical Technologists (AST) and Accrediting Agencies for Surgical Technology."

☐ 6. **Study** Information Sheet, Objective 6 through Objective 12.

☐ 7. **Research** Online resources to learn more about legal and ethical matters affecting the surgical technologist. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 8. **Read** Student Supplement 2, "The Patient's Bill of Rights" taken from the American Hospital Association Web site. Discuss the document with your instructor and make sure that you thoroughly understand its concepts.

☐ 9. **Do** Assignment Sheet 1, "Evaluate Legal Cases Involving Surgery."

☐ 10. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 11. If the evaluation is not satisfactory, repeat step 9.

☐ 11. **Do** Assignment Sheet 2, "Evaluate Ethical Issues Involving Medicine."

☐ 12. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat step 11.

☐ 13. **Check** With your instructor for any additional assignments to be completed.

☐ 14. **Do** Additional assignments your instructor lists below.

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☐ 15. **Take** Module Review provided by your instructor.

☐ 16. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 17. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

# Introduction to Surgical Technology
## Section A: Orientation to Surgical Technology
## Module 3-A: Legal and Ethical Responsibilities

### Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to complete statements concerning surgical conscience and ethics and match areas of legal responsibility to their correct definitions. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Discuss accountability for personal actions and obligations.
2. Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions.
3. List incidents that could result in litigation.
4. Define criteria used to establish negligence in court cases involving the surgical team.
5. Match terms related to credentialing to their correct definitions.
6. Discuss surgical conscience.
7. Complete statements concerning ethics.
8. List ways of making ethical decisions as a surgical technologist.
9. List resources that may help a surgical technologist interpret and follow professional standards of conduct.
10. List items in the surgical technologist's code of ethics.
11. Complete statements concerning standards of professional practice.
12. Select true statements concerning the Patient's Bill of Rights.
13. Evaluate legal cases involving surgery. (Assignment Sheet 1)
14. Evaluate ethical issues involving medicine. (Assignment Sheet 2)

## Information Sheet

OBJECTIVE 1

**Discuss accountability for personal actions and obligations.**

1. Within our society, people are legally accountable for actions taken in their personal and professional lives. When they deny their obligations, they can be held responsible and face lawsuits that result in financial restitution, imprisonment, and/or other actions.
2. Surgical technologists have legal and ethical responsibilities toward their patients.
3. Surgical technologists, their employers, and members of the surgical team can be held responsible for negligence for actions taken or not taken in the healthcare environment.
4. Surgical technologists must adhere to accepted standards, regulations, policies, and laws.
5. Surgical technologists are obligated to disclose details of their patient care and surgical procedure activities in written documentation and when called upon in legal proceedings.

✓ **NOTE:** Because of possible legal consequences, all surgical technologists should acquire **malpractice insurance**.

KEY TERM

**Malpractice insurance**—Insurance that protects a professional person such as a physician, surgical technologist, or dentist against an act of negligence

OBJECTIVE 2

**Match common areas of legal responsibility in surgery affecting the surgical technologist to their correct definitions.**

1. **Guiding Medical Principles**
   - ***Aeger primo***—Literally, "the patient first"; the motto of the Association of Surgical Technologists
   - **Doctrine of reasonable man**—The right of a patient to expect that professional and technical personnel will perform their duties and meet the standards of other reasonable, prudent, and honest personnel involved in similar circumstances
   - ***Primum non nocere***—Literally, "first, do no harm"; a guiding principle of the **Hippocratic** medical ethics

KEY TERM

**Hippocratic**—Having to do with traditional medical principles that require physicians to follow a high standard of moral conduct while practicing medicine

- ***Respondeat superior***—Literally, "a superior (or master) must answer"; employers are responsible for the acts and omissions of their employees
- ***Res ipsa loquitur***—Literally, "a thing that speaks for itself"; a defendant is guilty of negligence without the need to show their direct involvement; its use is limited to cases in which the cause of a plaintiff's injury was entirely under the control of the defendant, and presumably the injury could have been caused only by negligence

### 2. Accountability and Liability Terms

- **Accountability**—The expectation that an individual may be called to account for actions taken that were consistent with responsibilities contracted by virtue of employment or learner experience
- **Assault**—Unlawful threat to harm another physically
- **Battery**—The carrying out of physically-threatened harm
- **Liability**—The state of being answerable or responsible; being legally bound, as to make good any loss or damage that occurs in a transaction
- **Corporate liability**—The state of being legally responsible for the company's actions
- **Personal liability**—The state of being legally responsible for one's actions
- **Product liability**—Legal liability of manufacturers and sellers to compensate buyers, users, or others for damages or injuries caused by defects in their products

### 3. Law and Tort Terms

- **Advance directive**—Legally valid document written in advance of serious illness that state a patient's choices for health care, or names a second party to make those choices if the patient becomes unable to make decisions

  Examples: Living wills, health care proxies, or durable power of attorney for health care

- **Breach of confidentiality**—A violation of the obligation to keep a patient's records and confidences private
- **Common law**—Law established on the basis of previous court decisions
- **Complaint**—A legal process charging a party with a wrong done or a crime committed

- **Confidential communication**—A statement made to a lawyer, physician, or member of the clergy in confidence and implicitly understood that it shall remain a secret
- **Crime**—An illegal act against society
- **Defamation**—Wrongs of slander and libel
- **Defendant**—A person accused of a tort or crime who is required to make answer in a legal action or suit
- **Deposition**—Testimony of a witness or a party taken under oath outside the courtroom, the transcript of which becomes part of the court's file
- **Expert witness**—A person having special training or experience who assists a judge and jury in their decision-making process
- **Felony**—A serious crime punishable by law with penalties ranging from imprisonment to death
- **Iatrogenic injury**—An injury induced by a doctor or care giver
- **Invasion of privacy**—A wrong that violates a person's right to be free from unauthorized intrusion
- **Lack of proper supervision**—The supervisor, instructor, or physician is absent while the surgical technologist is performing their responsibilities, or the supervisor, instructor, or physician is not near enough to the technologist to give assistance
- **Libel**—A **written** defamation of character; an untruthful written statement about a person that subjects that person to ridicule or contempt
- **Litigation**—A lawsuit
- **Misdemeanor**—A crime of lesser offense than a felony, punishable by fines and/or imprisonment, usually for less than one year
- **Plaintiff**—One who commences a legal action or suit to obtain a remedy for an injury to his/her rights; the complaining party
- **Slander**—A **spoken** defamation of character; an untruthful oral statement about a person that subjects that person to ridicule or contempt
- **Statutory law**—Law enacted by Congress and state legislatures
- **Tort**—A private or civil wrong or injury for which the court provides a remedy through an action for damages

### 4. Negligence Terms

KEY TERM

**Negligence**—Failure to use care that a reasonable and prudent person would use under similar circumstances

✔ **NOTE:** There are two types of negligence:
**Commission**—The act of perpetrating an offense
**Omission**—The failure to perform what the law requires

- **Comparative negligence**—The degree of negligence in which each of the parties involved may be shown to have been responsible for the injury caused
- **Malpractice**—Any professional misconduct resulting in harm to another
- **Gross/criminal negligence**—An act or omission that is the result of actual conscious indifference to rights, safety, or welfare of persons
- **Incompetence**—Being unqualified or inadequate to perform a duty or duties

OBJECTIVE 3

**List operating room incidents that could result in litigation.**

1. **Misidentification of patient**
2. **Incorrect procedure**
3. **Incorrect sponge, needle, or instrument counts**
4. **Burns, falls, or injuries**
5. **Abandonment**
6. **Incorrect positioning**
7. **Improper care of specimens (including loss or misidentification)**
8. **Incorrect drugs or incorrect administration**
9. **Use of defective equipment or instruments**
10. **Improper care of patient's property (including loss or damage)**
11. **Lack of informed consent**
12. **Major break in aseptic technique**
13. **Documentation errors**
14. **Failure to observe critical events and to take appropriate action**

15. **Exceeding authority or accepted functions**
16. **Assault and battery**
17. **Breach of confidentiality**
18. **Invasion of privacy**
19. **Defamation**

OBJECTIVE 4 **Define criteria used to establish negligence in court cases involving the surgical team.**

✔ **NOTE:** The most common legal action in the medical environment is negligence.

1. **Damage**—The loss caused by one person to another or to their property, either with the design of injuring him, with negligence and carelessness, or by inevitable accident; the loss that someone has sustained and the gain which he has failed to make
2. **Dereliction/failure to meet standard**—Willful neglect of the standard of action in a particular situation
3. **Foreseeability of harm**—The degree to which an action could be anticipated to cause injury; a key issue in determining a person's liability

   ✔ **NOTE:** If a defendant could not reasonably have foreseen that someone might be hurt by their actions, then there would be no *foreseeability of harm* and thus no liability.

4. **Proximate (direct) cause of injury or damage**—When an action plays any part, no matter how small, in bringing about the injury or damage

   ✔ **NOTE:** Even if the violation operated in combination with the act of another or in combination with some other cause, the violation was a *proximate cause of injury or damage.*

5. **Standard of due care**—Criterion used by general agreement to denote an acceptable level of practice or an established norm; standards of care establish a basic model which measures the quality of practice

OBJECTIVE 5 **Match terms related to credentialing to their correct definitions.**

1. **Credentialing**—The process of establishing a minimum level of skills and knowledge for a professional activity

   ✔ **NOTE:** Surgical technologists may be awarded the following credentials: certificate of proficiency, diploma, or associate degree.

2. **Accreditation**—The formal recognition of an instructional program as conforming with a set of standards

   ✔ **NOTE:** For surgical technology, the CAAHEP (Commission on Accreditation of Allied Health Education Programs) verifies that instructional programs have met minimum standards.

3. **Certification**—Documentation that confirms that one has met the requirements of and may practice in a field; certification is voluntary not mandatory

   ✔ **NOTE:** Surgical technologists who have acquired a certificate or degree from a CAAHEP-accredited program and who wish to be certified as a Certified Surgical Technologist (CST) or Certified Surgical Technologist/Certified First Assistant (CST/CFA) may take the certification examination through the Liaison Council on Certification for the Surgical Technologist (LCC-ST).

4. **Licensure**—The granting of licenses to practice a profession; ensures that individual is qualified and has met certain educational and training standards; licensure is mandatory to practice a profession in which a license is available

   ✔ **NOTE:** Many states are passing licensing measures requiring surgical technologists to be licensed.

5. **Registration**—The act of listing qualified individuals in a registry

OBJECTIVE 6 **Discuss surgical conscience.**

✔ **NOTE:** Surgical conscience is based upon an attitude of truly caring about a patient. Surgical conscience involves the following:

1. **Protect patients from physical hazards in the operating room**
2. **Understand the patient's fears and anxieties concerning surgery**
3. **Act in a conscientious manner**
4. **Maintain professional honesty in actions as well as capabilities and qualifications**
5. **Maintain aseptic technique**
6. **Strive to contain costs**
7. **Treat patient information confidentially by respecting the patient's rights to privacy, property, dignity, and identity**
8. **Treat patients in a nondiscriminatory manner**

OBJECTIVE 7 **Complete statements concerning ethics.**

KEY TERM

**Ethics**—Principles that govern human conduct and values

1. **Ethics are influenced by cultural, socio-economic, and religious backgrounds as well as life experiences.**
2. **Ethics should govern professional conduct.**
3. **Ethics and laws are closely related because legal doctrines often interpret ethical concepts.**
4. **Principles of ethical decision-making in clinical practice include:**
   - **Autonomy**—Individual's freedom of choice and their right to make decisions that determine a course of action
   - **Beneficence**—Duty to assist others in determining their best interest or the cause of possible harm
   - **Fidelity**—Right of the individual to trust that his/her dignity, privacy, and confidentiality will be protected
   - **Justice**—Distribution of resources a person has the right to receive or claim
   - **Nonmaleficence**—Duty to do no harm

OBJECTIVE 8 **List ways of making ethical decisions as a surgical technologist.**

✔ **NOTE:** For healthcare employees, there are medical ethics that govern professional conduct. However, personal ethics may sometimes conflict with professional responsibilities. When faced with an ethical situation, it is important to analyze the issue in a rational manner. Since these situations could occur in the midst of a surgery, the surgical technologist must be prepared in advance.

1. **Identify the moral aspects of care**
2. **Gather relevant facts related to a moral issue**
3. **Clarify and apply personal values**
4. **Understand ethical theories and principles**
5. **Utilize competent interdisciplinary resources**
6. **Propose alternative actions**
7. **Apply codes of ethics to help guide actions**

8. **Choose and act on resolutive action**
9. **Participate actively in resolving issues**
10. **Apply state/federal laws governing practice**
11. **Evaluate the resolutive action to be taken**

✔ **NOTE:** The surgical technologist should periodically review their legal responsibilities, the surgical technologist's code of ethics, and their belief systems. Excuse yourself from potentially problematic procedures.

OBJECTIVE 9 **List resources that may help a surgical technologist interpret and follow professional standards of conduct.**

✔ **NOTE:** Surgical technologists must adhere to organizational policies, standards of practice, and codes of ethics as well as federal and state laws and regulations. Read and understand all materials provided by your instructor and employer. When in doubt you must ask questions until you have a thorough understanding of the requirements.

1. **Continuing education**
2. **Colleagues and experienced health care professionals**
3. **Medical journals**
4. **World Wide Web**

✔ **NOTE:** Always remember that responsibility for the validity of information falls upon the healthcare worker. *If the situation is serious enough, the healthcare worker should seek legal counsel.*

OBJECTIVE 10 **List items in the surgical technologist's code of ethics.**

✔ **NOTE:** The Association of Surgical Technologists' Board of Directors adopted the following code of ethics in 1985.

1. **To maintain the highest standards of professional conduct and patient care**
2. **To hold in confidence, with respect to the patient's beliefs, all personal matters**
3. **To respect and protect the patient's legal and moral rights to quality patient care**
4. **To not knowingly cause injury or any injustice to those entrusted to our care**
5. **To work with fellow technologists and other professional health groups to promote harmony and unity for better patient care**
6. **To always follow the principles of asepsis**
7. **To maintain a high degree of efficiency through continuing education**
8. **To maintain and practice surgical technology willingly, with pride and dignity**

9. **To report any unethical conduct or practice to the proper authority**

10. **To adhere to the code of ethics at all times with all members of the health care team**

OBJECTIVE 11 **Complete statements concerning standards of professional practice.**

1. **Standards of professional practice describe activities related to quality assurance, education, ethical behavior, and accountability.**

2. **Standards are set and maintained by each medical facility to provide guidelines for patient care and safety.**

3. **Personnel must adhere to established policies and procedures to protect themselves, other workers, and the medical facility from litigation.**

4. **The following are standards of practice that should be followed by the surgical technologist:**

   - Teamwork is essential for perioperative care and contingent upon interpersonal skills
   - Preoperative planning and preparation for surgical intervention are individualized to meet the needs of the patient and surgeon
   - Preparation of the surgical suite/clinical area and all supplies and equipment will ensure environmental safety for patients and personnel
   - Application of basic and current knowledge is necessary for a proficient performance of assigned functions
   - Each patient's rights to privacy, dignity, safety, and comfort are respected and protected
   - Every patient is entitled to the same application of aseptic techniques within the physical facilities

OBJECTIVE 12 **Select true statements concerning the Patient's Bill of Rights.**

✔ **NOTE:** The Patient's Bill of Rights was adopted by the American Hospital Association in 1973 and later modified in 1992. It is intended to promote more effective patient care. Refer to Student Supplement 2 for the complete Patient's Bill of Rights.

1. **The patient has the right to considerate and respectful care**

2. **The patient has the right to obtain from the physician complete current information concerning diagnosis, treatment, and prognosis in terms the patient can reasonably be expected to understand**

3. **The patient has the right to receive from the physician information necessary to give informed consent or refusal to any procedure or treatment to the extent permitted by law and hospital policy**

4. The patient has the right to set up an advance directive (such as a living will, health care proxy, or durable power of attorney for health care) concerning treatment or designating a surrogate decision maker

5. The patient has the right to every consideration of privacy concerning case discussion, consultation, examination, and treatment

6. The patient has the right to expect that all communications and records will be treated as confidential by the hospital to the extent permitted by law

7. The patient has the right to access records pertaining to the patient's medical care and to have the information explained except when restricted by law

8. The patient has the right to expect a hospital within its capacity to make reasonable response to a patient's request for services

9. The patient has the right to obtain information about any relationship of the involved hospital to other health care and educational institutions in so far as the patient's care is concerned

10. The patient has the right to refuse to participate in human experimentation requiring direct patient involvement, and to have those studies fully explained prior to consent

11. The patient has the right to expect reasonable continuity of care

12. The patient has the right to be informed of hospital policies and practices, resources for resolving grievances, and charges for services

## Student Supplement 1—The Association of Surgical Technologists (AST) and Accrediting Agencies for Surgical Technology

### Association of Surgical Technologists, Inc.

The Association of Surgical Technologists, Inc. (AST) is the professional organization for surgical technologists. Formerly called the Association of Operating Room Technicians, its name was changed in 1978 to reflect the occupation's nationally recognized job title of "surgical technologist." Today, AST strives to

- Maintain a high level of education and skills among its members
- Promote the interests of members in regulatory and legislative matters
- Perform in a public relations role with the healthcare industry as well as the general public

Membership is optional, but it is strongly encouraged. It shows your employer that you are serious about your career choice and offers benefits such as continuing education opportunities, professional certification, and special offers on professional liability insurance.

AST has a number of free publications that describe the responsibilities and personal profile of the surgical technologist, historical background of the organization, goals, purpose, membership composition, committees, meetings, an annual conference, disciplinary measures, licensing, certification, anticipated salary levels, and benefits of membership. *The Surgical Technologist*, AST's monthly journal, provides members with information on current trends and practices in the field of surgical technology. AST maintains a comprehensive Web site at http://www.ast.org or can be contacted by phone (303-694-9130) or at the following address:

Association of Surgical Technologists
7108-C South Alton Way
Englewood, CO 80112

### Accrediting Agencies

Accrediting agencies are independent, nongovernmental professional organizations that establish standards, set guidelines, and evaluate and recognize the quality of both institutions and educational programs. The accreditation process examines goals, activities, and achievements; provides criticism and suggestions of a visiting team of professional examiners; and recommends changes. Accreditation is a rigorous process that provides the public with quality health care facilities, educational institutions, and training programs.

Surgical technology students should be aware of two accrediting agencies.

- The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) provides accreditation at the institutional level.
- The Commission on Accreditation of Allied Health Education Programs (CAAHEP) provides accreditation at the programmatic level.

### JCAHO Accreditation Procedures

JCAHO has accredited nearly 20,000 hospitals and health care providers in the United States and foreign countries. It measures health care organizations against minimum national standards and provides objective evidence of an organization's performance. JCAHO sends teams of doctors, nurses, and other health care professionals to conduct performance surveys at organizations that are seeking to obtain or maintain accreditation.

The survey report provides detailed strengths, weaknesses, and recommendations on how to improve. Accreditation instills public confidence, helps meet licensing and regulatory requirements, and has positive ramifications for insurance and managed care decisions. To earn and maintain accreditation, healthcare organizations must undergo an on-site survey by a Joint Commission survey team at least every three years. Laboratories must be surveyed every two years.

### CAAHEP Accreditation for Surgical Technology Programs

Most Certified Surgical Technologists (CSTs) receive their education through accredited programs at community and junior colleges, vocational and technical schools, the military, universities, and structured hospital training programs. These programs are accredited by CAAHEP. This agency certifies that surgical technology and other allied health education programs offered by these institutions meet performance criteria for classroom and supervised clinical training. Surgical technology programs accredited by CAAHEP meet standards and guidelines developed by the Association of Surgical Technologists (AST), the American College of Surgeons (ACS), and educational specialists within the CAAHEP staff.

✓ **NOTE:** The American College of Surgeons (ACS) is a professional organization dedicated to improving patient care by placing emphasis on educational attainment and higher professional standards.

The Accreditation Review Committee on Education in Surgical Technology (ARC-ST) works under the auspices of CAAHEP. ARC-ST works directly with each surgical technology program in the accreditation process. ARC-ST is composed of representatives from ACS, the American Hospital Association (AHA), and AST. It performs an on-site evaluation to gather data on each program and then meets twice a year to make recommendations. CAAHEP accredits programs based upon these recommendations.

Program elements that are reviewed by ARC-ST include the following:

- Faculty
- Student/faculty ratio
- Financial resources
- Physical resources
- Learning resources
- Admissions policies
- Student records
- Curriculum
- Student evaluation methods

Organizations must have institutional accreditation from JCAHO prior to applying for accreditation for their surgical technology program. Programs must be reviewed every 4 to 6 years and submit regular compliance reports to ARC-ST.

ARC-ST accredited programs provide the health care community with employees that have a nationally accepted level of education, skill, and training. It benefits students by giving them the job skills necessary to perform surgical technology duties anywhere in the country.

✔ **NOTE:** AST-sponsored scholarships are only available to students of an ARC-ST accredited program. More importantly, only graduates of an ARC-ST accredited program or previously certified surgical technologists are eligible for the surgical technology certification examination.

CAAHEP is the only accrediting body recognized by the Liaison Council on Certification for the Surgical Technologist (LCC-ST), the organization that administers the surgical technology certification exam. To retain certification, a certified surgical technologist must earn 80 credits every six years or successfully retake the certifying exam. A CST may choose to complete specialized training and take the exam to be certified as a surgical first assistant.

## Student Supplement 2—The Patient's Bill of Rights

The Patient's Bill of Rights was adopted by the American Hospital Association in 1973 and revised on October 21, 1992.

**INTRODUCTION**

*Effective health care requires collaboration between patients and physicians and other health care professionals. Open and honest communication, respect for personal and professional values, and sensitivity to differences are integral to optimal patient care. As the setting for the provision of health services, hospitals must provide a foundation for understanding and respecting the rights and responsibilities of patients, their families, physicians, and other caregivers. Hospitals must ensure a health care ethic that respects the role of patients in decision making about treatment choices and other aspects of their care. Hospitals must be sensitive to cultural, racial, linguistic, religious, age, gender, and other differences as well as the needs of persons with disabilities.*

*The American Hospital Association presents A Patient's Bill of Rights with the expectation that it will contribute to more effective patient care and be supported by the hospital on behalf of the institution, its medical staff, employees, and patients. The American Hospital Association encourages health care institutions to tailor this bill of rights to their patient community by translating and/or simplifying the language of this bill of rights as may be necessary to ensure that patients and their families understand their rights and responsibilities.*

**BILL OF RIGHTS**

*These rights can be exercised on the patient's behalf by a designated surrogate or proxy decision maker if the patient lacks decision-making capacity, is legally incompetent, or is a minor.*

1. *The patient has the right to considerate and respectful care.*

2. *The patient has the right to and is encouraged to obtain from physicians and other direct caregivers relevant, current, and understandable information concerning diagnosis, treatment, and prognosis.*

   *Except in emergencies when the patient lacks decision-making capacity and the need for treatment is urgent, the patient is entitled to the opportunity to discuss and request information related to the specific procedures and/or treatments, the risks involved, the possible length of recuperation, and the medically reasonable alternatives and their accompanying risks and benefits.*

   *Patients have the right to know the identity of physicians, nurses, and others involved in their care, as well as when those involved are students, residents, or other trainees. The patient also has the right to know the immediate and long-term financial implications of treatment choices, insofar as they are known.*

3. *The patient has the right to make decisions about the plan of care prior to and during the course of treatment and to refuse a recommended treatment or plan of care to the extent permitted by law and hospital policy and to be informed of the medical consequences of this action. In case of such refusal, the patient is entitled to other appropriate care and services that the hospital provides or transfer to another hospital. The hospital should notify patients of any policy that might affect patient choice within the institution.*

4. *The patient has the right to have an advance directive (such as a living will, health care proxy, or durable power of attorney for health care) concerning treatment or designating a surrogate decision maker with the expectation that the hospital will honor the intent of that directive to the extent permitted by law and hospital policy.*

   *Health care institutions must advise patients of their rights under state law and hospital policy to make informed medical choices, ask if the patient has an advance directive, and include that information in patient records. The patient has the right to timely information about hospital policy that may limit its ability to implement fully a legally valid advance directive.*

5. *The patient has the right to every consideration of privacy. Case discussion, consultation, examination, and treatment should be conducted so as to protect each patient's privacy.*

6. *The patient has the right to expect that all communications and records pertaining to his/her care will be treated as confidential by the hospital, except in cases such as suspected abuse and public health hazards when reporting is permitted or required by law. The patient has the right to expect that the hospital will emphasize the confidentiality of this information when it releases it to any other parties entitled to review information in these records.*

7. *The patient has the right to review the records pertaining to his/her medical care and to have the information explained or interpreted as necessary, except when restricted by law.*

8. *The patient has the right to expect that, within its capacity and policies, a hospital will make reasonable response to the request of a patient for appropriate and medically indicated care and services. The hospital must provide evaluation, service, and/or referral as indicated by the urgency of the case. When medically appropriate and legally permissible, or when a patient has so requested, a patient may be transferred to another facility. The institution to which the patient is to be transferred must first have accepted the patient for transfer. The patient must also have the benefit of complete information and explanation concerning the need for, risks, benefits, and alternatives to such a transfer.*

9. *The patient has the right to ask and be informed of the existence of business relationships among the hospital, educational institutions, other health care providers, or payers that may influence the patient's treatment and care.*

10. *The patient has the right to consent to or decline to participate in proposed research studies or human experimentation affecting care and treatment or requiring direct patient involvement, and to have those studies fully explained prior to consent. A patient who declines to participate in research or experimentation is entitled to the most effective care that the hospital can otherwise provide.*

11. *The patient has the right to expect reasonable continuity of care when appropriate and to be informed by physicians and other caregivers of available and realistic patient care options when hospital care is no longer appropriate.*

12. *The patient has the right to be informed of hospital policies and practices that relate to patient care, treatment, and responsibilities. The patient has the right to be informed of available resources for resolving disputes, grievances, and conflicts, such as ethics committees, patient representatives, or other mechanisms available in the institution. The patient has the right to be informed of the hospital's charges for services and available payment methods.*

## CONCLUSION

*Hospitals have many functions to perform, including the enhancement of health status, health promotion, and the prevention and treatment of injury and disease; the immediate and ongoing care and rehabilitation of patients; the education of health professionals, patients, and the community; and research. All these activities must be conducted with an overriding concern for the values and dignity of patients.*

*The collaborative nature of health care requires that patients, or their families/surrogates, participate in their care. The effectiveness of care and patient satisfaction with the course of treatment depend, in part, on the patient fulfilling certain responsibilities. Patients are responsible for providing information about past illnesses, hospitalizations, medications, and other matters related to health status. To participate effectively in decision making, patients must be encouraged to take responsibility for requesting additional information or clarification about their health status or treatment when they do not fully understand information and instructions. Patients are also responsible for ensuring that the health care institution has a copy of their written advance directive if they have one. Patients are responsible for informing their physicians and other caregivers if they anticipate problems in following prescribed treatment.*

*Patients should also be aware of the hospital's obligation to be reasonably efficient and equitable in providing care to other patients and the community. The hospital's rules and regulations are designed to help the hospital meet this obligation. Patients and their families are responsible for making reasonable accommodations to the needs of the hospital, other patients, medical staff, and hospital employees. Patients are responsible for providing necessary information for insurance claims and for working with the hospital to make payment arrangements, when necessary.*

*A person's health depends on much more than health care services. Patients are responsible for recognizing the impact of their life-style on their personal health.*

*A Patient's Bill of Rights.* Retrieved December 19, 2001, from American Hospital Association Web site: http://www.aha.org/resource/pbillofrights.asp

**OBJECTIVE 13**

## Assignment Sheet 1—Evaluate Legal Cases Involving Surgery

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Understanding of legal concepts was demonstrated | ______ |
| • Written evaluation was clear and concise | ______ |
| • Correct grammar, punctuation, and spelling were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

______________________________________________

______________________________________________

**EXERCISE**

**DIRECTIONS** Read each scenario below. Describe what could have been done to prevent the incident. State whether or not you agree with the court's decision and briefly state why. Use complete sentences in your answers. Once you've completed this assignment, give it to your instructor for evaluation.

**SCENARIO 1** A patient came out of surgery with a scalpel blade in his bladder necessitating later corrective surgery. The hospital contended that the nurse was a borrowed employee of the surgeon while in the operating room. Therefore, when the nurse failed to report a missing surgical instrument, the surgeon should have been liable. The court, however, said that operating room nurses may have two masters, and negligence may be attributed to both. The hospital and the surgeon had a mutual interest in treating the patient, and each would have benefited by an accurate count of scalpel blades.

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______________________________________________

**Scenario 2**

A physician removed a cyst from each of a patient's breasts for examination to see if the cysts were malignant. As they were removed, the cysts were placed in one container and were essentially undifferentiated. The scrub nurse asked if the surgeon wanted the specimens separated. He said no because they were not malignant anyway. Once cyst was malignant. The plaintiff had to have both breasts removed. She was awarded $100,000 by the jury against both the surgeon and hospital.

**Scenario 3**

Action was brought against a surgeon when an electric cautery machine burned a patient during a hemorrhoidectomy. The machine had been used four times earlier that same day. The first two times that the surgeon attempted to use the machine during the hemorrhoidectomy, it did not deliver sufficient heat to cauterize the vessels, and the surgeon requested the circulating nurse to check it. Thereafter, the machine worked satisfactorily, and the operation was completed. After the operation, it was discovered that the patient was burned where she had come in contact with the electrode. The case was settled before trial as to the hospital and the nurse. The court held the surgeon not liable, stating that where opportunities for prevention of injury to a patient depend on the care with which the equipment is monitored and with the selection and training or personnel to operate it, it is proper to place the burden of defective equipment and negligent personnel on the hospital.

**Scenario 4**

A rongeur broke off while a surgeon was manipulating it in a patient's spinal column during a surgical procedure. The court held that where an unconscious or helpless plaintiff suffers an admitted mishap unrelated to the scope of surgery and res ipsa loquitur applies, the burden of proof shifts to all those who owed the patient a duty of care or a duty not to furnish a defective instrument.

**Scenario 5**

A healthy 6-year-old boy was admitted to the hospital for corrective eye surgery. While in the operating room, he suffered cardiac arrest and brain damage, resulting in his becoming a spastic quadriplegic, blind, and mute. Testimony in the case indicated the following: 90 percent of deaths resulting from cardiac arrest during surgery occur because of faulty intubation; if the open-heart massage had been performed within three minutes of the heart's stopping, brain damage would not have occurred; an elevated temperature and apprehension increase the risk of complication; the child was very agitated before surgery and had an elevated temperature; the preoperative record of the patient's temperature had been altered to reflect a normal temperature. The court felt that all this evidence would permit the doctrine of res ipsa loquitur to be applied. Damages of $4 million were awarded.

**Scenario 6**

The patient was told that a biopsy of his parotid gland needed to be done. This procedure would require a 1-inch incision in his neck. Instead, the parotid gland was removed. The patient had a permanent 8-inch scar and a concavity in his neck. Subsequently, plastic surgery was required to remove the scar tissue. The patient was awarded $50,000 in damages based on the inadequacy of the consent.

**Scenario 7**

A patient was admitted for skin grafting surgery. The surgeon was to remove a patch of skin from the front of her right thigh where she had previously sustained electrical burns. An alleged defect in the electrical surgical instrument, consisting of a bent spring impairing the usefulness of the depth setting adjustment of the instrument, caused deep cuts to the plaintiff. A judgment of $10,000 was allowed to stand against the institution. The court stated that the surgeon should be able to rely on the hospital to furnish safe equipment.

**SCENARIO 8**

The patient had extensive abdominal surgery. Postoperatively, the surgeon issued 11 orders including one requiring the checking and recording of the patient's vital signs—including temperature, pulse, respiration, and blood pressure every 15 minutes for 1 hour and then ever hour for 10 hours. Despite this order, the patient's temperature was recorded only four times during a 24-hour period. During one such time gap the patient's temperature rose from 101.4 degrees F to 105.2 degrees F. On the day of surgery, a nurse placed tissue over the incision to stop the bleeding. The patient suffered severe brain damage. The court held that the hospital failed to render reasonable postoperative care and that this caused an infection leading to fever and brain damage. The patient received an award of $800,000.

**SCENARIO 9**

A woman was brought into the hospital for a condition of the cervix. She was taken into the operating room by a surgical technologist and was thought to be another patient who was to have a thyroidectomy. Within a short time, the surgeon was informed that he had the wrong patient on the operating table, and the surgery was terminated. The thyroidectomy was not completed, and such incisions as had been made were sutured and repaired. The patient had a 4-inch incision along her neck that became infected and required cosmetic surgery. The court held that the jury's verdict of $100,000 was not excessive in view of the critical duty placed upon the surgeon, the anesthesiologist, and the surgical technologist to establish with absolute certainty the identity of a surgical patient. All parties admitted that they did not check the identity of the patient against the name on the bracelet. The fact that the patient responded to the wrong name was not accepted as a defense by the court.

**SCENARIO 10** A patient was admitted to a medical center for an anterior cervical fusion. Because of a mishap involving equipment used during surgery, he became a quadriplegic. The surgical resident used a Stryker plug cutter to remove bone from the vertebrae. When she removed the instrument, she found it had taken a full depth of vertebrae tissue and penetrated to the cortex. A scratch was noted in the instrument that could have caused a screw to slip. The court stated that preoperative checks should be made on surgical equipment to prevent patient harm.

**SCENARIO 11** A surgeon ordered a nurse to prepare a 10 percent cocaine solution with epinephrine for a tonsillectomy patient as an anesthetic. The patient convulsed and died. The physician had meant procaine. Even though the nurse repeated the order, she was found guilty for not questioning it. The nurse was convicted of manslaughter.

**OBJECTIVE 14**

# Assignment Sheet 2—Evaluate Ethical Issues Involving Medicine

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • All questions were answered | ______ |
| • One issue was researched | ______ |
| • Sources were documented | ______ |
| • Written evaluation was clear and concise | ______ |
| • Correct grammar, punctuation, and spelling were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

______________________________

______________________________

**EXERCISE**

**DIRECTIONS**

Respond to each of the questions on the following pages by stating your opinion. Select one question and research **both** sides of the issue. Check your library for medical journals, as well as news magazines such as *Newsweek* or *Time* for others' opinions and for more information. You may also choose to research the issues on the Internet or interview various people in your community for their opinions. These could include medical ethics committee representatives from a local medical center, family doctors, parents, church leaders, teachers, fellow students, etc. Be sure to include both sides of the issue.

Prepare a 1–2 page written evaluation of the issue, describing both sides of the argument, your opinion of the problem, and why you have that opinion. Conclude your evaluation by stating how this ethical issue can impact on your career as a surgical technologist. Provide bibliographic documentation of your sources. Include publications, interviews, and Web sites on your list. Complete this assignment and give it to your instructor for evaluation. Your instructor may prefer to have oral reports or panel discussions.

1. When does life begin?

2. When does life end?

3. Should medical technology be used to save a person's life?

4. Should medical technology be used to prolong the lives of the chronically or terminally ill?

5. Do patients have the right to refuse medical treatments that could save or prolong their lives?

6. Do parents of the very young or children of the aged have the right to refuse treatments for these family members?

7. Should euthanasia (mercy killing) be practiced by doctors? Nurses? Family members?

8. Should medical centers refuse treatment for patients who cannot pay?

9. Who should pay for the medical care of patients who cannot pay?

10. Under what conditions, if any, should abortions be performed?

11. Under what conditions, if any, should sterilization or infertility procedures be performed?

12. Should genetic engineering be used to correct human genetic diseases?

13. Should a person be allowed to surgically change their gender?

______________________________________________

______________________________________________

______________________________________________

14. Should cloning be used to produce transplant organs?

______________________________________________

______________________________________________

______________________________________________

15. Should doctors spare no expense to care for AIDS patients who will most likely die regardless of treatment?

______________________________________________

______________________________________________

______________________________________________

16. Is substance addiction a matter of privacy despite federal and state laws?

______________________________________________

______________________________________________

______________________________________________

# Introduction to Surgical Technology

## SECTION B:
## Safety

### Module 1-B: Environmental Safety

# Introduction to Surgical Technology
# Section B: Safety
# Module 1-B: Environmental Safety

## Module Contents

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**PREREQUISITES:** None

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1.

☐ 5. **Research** Online resources to learn more about environmental safety. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Do** Assignment Sheet 1, "Subscribe to a Safety Pledge."

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 4 and 6.

**Optional** ☐ 8. **View** Videotape entitled *Safety Orientation—Nursing*.

☐ 9. **Study** Information Sheet, Objective 2.

☐ 10. **Do** Assignment Sheet 2, "Complete an Accident Report Form."

☐ 11. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 12. If the evaluation is not satisfactory, repeat steps 9 and 10.

☐ 12. **Study** Information Sheet, Objective 3.

**Optional** ☐ 13. **View** Videotape entitled *Hazardous Energy Source (Lockout-Tagout)*.

☐ 14. **Study** Information Sheet, Objective 4 through Objective 9.

☐ 15. **Read** Student Supplement 1, "Guidelines for Interpreting Material Safety Data Sheets."

☐ 16. **Do** Assignment Sheet 3, "Interpret Material Safety Data Sheets."

☐ 17. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 18. If the evaluation is not satisfactory, repeat steps 14 through 16.

**Optional**

☐ 18. **View** Videotape entitled *Back Safety for Health Care Providers.*

☐ 19. **Study** Information Sheet, Objective 10.

☐ 20. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 21. **Do** Job Sheet 1, "Use Proper Body Mechanics in Standing, Sitting, Moving, and Lifting."

☐ 22. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 23. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat steps 19 and 21.

☐ 23. **Study** Information Sheet, Objective 11 and Objective 12.

☐ 24. **Read** Student Supplement 2, "Tornado Tips."

☐ 25. **Do** Assignment Sheet 4, "Analyze Severe Weather Scenarios."

☐ 26. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 27. If the evaluation is not satisfactory, repeat steps 23 through 25.

☐ 27. **Study** Information Sheet, Objective 13 through Objective 15.

☐ 28. **Do** Assignment Sheet 5, "Analyze Fire Emergency Scenarios."

☐ 29. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 30. If the evaluation is not satisfactory, repeat steps 27 and 28.

**Optional**

☐ 30. **View** Videotape entitled *Fire Extinguisher Training and Use 2000.*

☐ 31. **Study** Information Sheet, Objective 16 through Objective 22.

☐ 32. **Observe** Demonstration of procedures to be used in completing Job Sheet 2.

☐ 33. **Do** Job Sheet 2, "Operate a Portable Fire Extinguisher."

☐ 34. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 35. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat steps 31 and 33.

Optional 📼

☐ 35. **View** Videotape entitled *Fire Protection/Electrical Safety.*

☐ 36. **Study** Information Sheet, Objective 23 and Objective 24.

☐ 37. **Do** Assignment Sheet 6, "Apply Safety Principles to the School and Workplace."

☐ 38. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 39. If the evaluation is not satisfactory, repeat steps 36 and 37.

☐ 39. **Take** Written Test provided by your instructor.

☐ 40. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 41. If the evaluation is not satisfactory, repeat steps 4, 9, 12, 14, 19, 23, 27, 31, and 36.

☐ 41. **Check** With your instructor for any additional assignments to be completed.

☐ 42. **Do** Additional assignments your instructor lists below.

________________________________________

________________________________________

________________________________________

☐ 43. **Take** Module Review provided by your instructor.

☐ 44. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 45. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, job sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to follow evacuation and personal safety guidelines for conducting yourself safely at school and at work. You should demonstrate these competencies by completing the assignment sheets and job sheets and by scoring 100 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Discuss ways of developing a good safety attitude.
2. Complete statements concerning personal safety guidelines.
3. List general steps/guidelines for reporting defective equipment.
4. List expectations for a safe environment at school or work.
5. State the purposes of a material safety data sheet (MSDS).
6. Match MSDS sections to the information each section contains.
7. Match hazard placard and label symbols to their hazards.
8. Identify hazards using the NFPA 704 hazard triangle.
9. Match methods by which a hazardous material can enter the body to their correct descriptions.
10. Complete statements concerning the principles of body mechanics.
11. List basic types of emergencies.
12. Discuss severe weather safety guidelines.
13. Arrange in order the steps to follow on receiving a bomb threat.
14. Complete guidelines for general evacuation procedures in a fire emergency.
15. Describe the disabled person's fire evacuation responsibilities.
16. Identify the components of fire by labeling the sides of a fire tetrahedron.
17. Match fire classifications to their fuel sources.
18. Match fire extinguisher symbol shapes to fire classification letters.
19. Match extinguisher pictographs to the extinguisher's intended applications.
20. List the characteristics of fires appropriate for handling with a portable fire extinguisher.

21. Arrange in order the basic steps in using a fire extinguisher.
22. List fire prevention guidelines.
23. Complete statements concerning electrical safety.
24. Select true statements concerning basic equipment safety.
25. Subscribe to a safety pledge. (Assignment Sheet 1)
26. Complete an accident report form. (Assignment Sheet 2)
27. Interpret material safety data sheets. (Assignment Sheet 3)
28. Analyze severe weather scenarios. (Assignment Sheet 4)
29. Analyze fire emergency scenarios. (Assignment Sheet 5)
30. Apply safety principles to the school and workplace. (Assignment Sheet 6)
31. Use proper body mechanics in standing, sitting, moving, and lifting. (Job Sheet 1)
32. Operate a portable fire extinguisher. (Job Sheet 2)

## Information Sheet

**OBJECTIVE 1** **Discuss ways of developing a good safety attitude.**

✔ **NOTE:** Developing a positive attitude toward safety can save you money, your job, and even your life. Don't think "It can't happen to me." It does every day.

1. **Focus on the task at hand.**
2. **Stay alert; accidents happen easily when you are tired or bored.**
3. **Take time to do the job right; do not take shortcuts.**

   ✔ **NOTE:** Staying safe may take a little extra time, but it results in fewer mistakes.

4. **Determine your priorities—what needs to be done first, second, and so on—so that you do not run out of time to complete high-priority tasks.**
5. **Use your head; think before you act.**
6. **Do not fool around or let emotions such as anger or frustration get in the way of your doing a job safely.**
7. **Take responsibility for your actions and for those of your team.**

   ✔ **NOTE:** Others trust and depend on you to do your job correctly. If you or your team does not act responsibly, others may suffer. Understand that safety is everyone's responsibility.

8. **Avoid unnecessary risks.**

   ✔ **NOTE:** Think of what could happen if you take a chance on performing a task unsafely.

**OBJECTIVE 2** **Complete statements concerning personal safety guidelines.**

1. **Know the correct emergency telephone numbers in your area; be sure that they are posted near the telephone.**

   Examples: Fire and police departments, ambulance service, poison-control center

2. **Comply with all safety rules and posted signs.**
3. **Be alert to dangers and hazards.**
4. **Be familiar with the location of fire-fighting and first-aid equipment.**
5. **Use the right tool or equipment for the job, and use it properly.**

6. **Follow instructions when performing a task.**

7. **Wear personal protective equipment (safety glasses, gloves, etc.) as required.**

8. **Use and store potentially hazardous materials and products strictly according to the label instructions and cautions.**

9. **Never transfer the contents of a container from the original container to another unauthorized container.**

   Example: Removing sanitizer from its original, labeled container and placing it in a spray bottle or other container.

10. **Never operate, adjust, modify, or repair equipment without permission and proper training.**

11. **Tag and report defective equipment immediately.**

12. **Follow all safety guidelines set by the management.**

13. **Correct or report all unsafe conditions immediately.**

    Examples: Spills, boxes piled in the hallway and blocking a fire exit

14. **Report all accidents and get first aid immediately.**

    ✔ **NOTE:** *All* accidents must be reported, no matter how minor the accident appears.

15. **Use proper body mechanics.**

16. **Keep your work area clean and neat.**

17. **Always conduct yourself in a safe manner.**

18. **Do not participate in horseplay or play jokes on others.**

OBJECTIVE 3 **List general steps/ guidelines for reporting defective equipment.**

✔ **NOTE:** If you find any equipment that is defective or needs repair, follow your organization's specific **lockout/tag-out** procedures.

KEY TERMS

**Lockout**—Procedure ensuring that all hazardous energy sources (gas, electricity, hydraulic systems) to a defective tool or machine are locked in the OFF position before maintenance is performed

**Tag-out**—Procedure in which special tags are used to warn others not to operate the equipment; the tag contains a printed warning of what will happen if the power is turned on

1. **Visually inspect all electrical equipment before and after each use for any signs of defects or malfunctions.**

2. **Immediately notify your instructor if you discover a defective piece of equipment.**

3. **Lockout the equipment per the organization's *SOPs*** (see Figure 1 below).

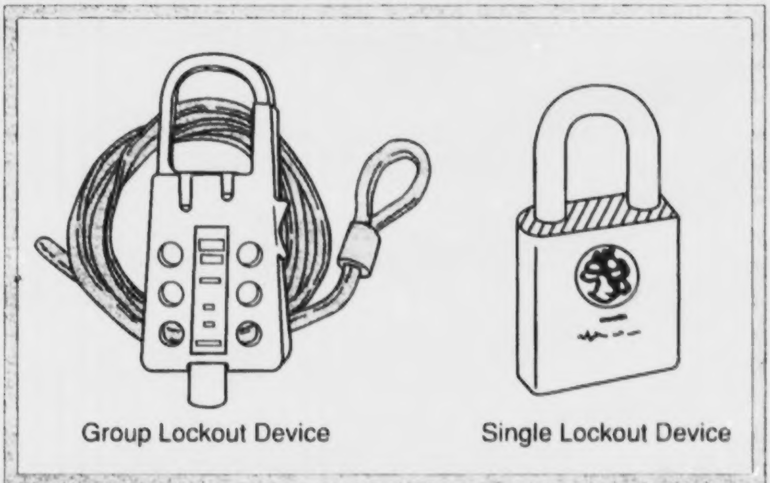
> KEY TERM
>
> **SOP**—Standard operating procedure

4. **Tag-out the equipment per the organization's SOPs** (see Figure 2 below).

   ✔ **NOTE:** Use the lockout procedure whenever possible. Use the tag-out procedure to back up the lockout system or when the lockout system is unavailable. Remember: Tags do not prevent the equipment from being started up, so if the tag system is used alone, exercise extra caution.

5. **Remove the piece of equipment from the operations area if possible.**

6. **Do not use the lockout lock and key for any other purpose.**



Group Lockout Device

Single Lockout Device

**Figure 1**
Lockout devices

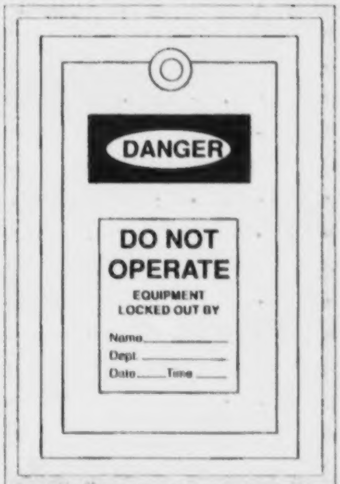


**Figure 2**
Sample tag

**OBJECTIVE 4** **List expectations for a safe environment at school or work.**

1. **Adequate lighting to prevent eyestrain and to allow performance of required duties**

2. **Clean air**

3. **Comfortable, *ergonomic* seating and equipment that encourages good *body mechanics*.**

KEY TERMS

**Ergonomic**—The science of designing and arranging equipment so that the equipment and the people who use it interact most efficiently and safely

Examples: A mouse pad with an integral wrist rest; curved computer keyboards; desk chairs with adjustable heights and backs

**Body mechanics**—The use of the body to maintain balance and to achieve motion

Examples: Good posture, safe lifting techniques

4. **Working emergency alarm and lighting systems**
5. **Clearly marked, unlocked, and accessible emergency exits**
6. **Clear, barrier-free, walkways accessible to all**
7. **Posted safety rules**
8. **Posted evacuation routes and rules**
9. **Mandatory safety training available to all**
10. **Available personal protective equipment**
11. **Designated smoking and nonsmoking areas**
12. **Clearly identified hazardous materials**
13. **Available *material safety data sheets* (MSDS) on all hazardous materials in the organization**

KEY TERM

**Material safety data sheet (MSDS)**—Form that explains each hazardous material used by an organization

14. **Lighted, open parking and entrance areas**
15. **Up-to-date, operable fire extinguishers**

OBJECTIVE 5 **State the purposes of a material safety data sheet (MSDS).**

1. **To inform the user of the material's physical properties or fast-acting health effects that make it dangerous to handle**

2. **To tell the user the level of protective gear needed**
3. **To tell the user the first-aid treatment necessary if exposed to the product or its hazards**
4. **To tell management and the user the preplanning needed for safely handling spills, fires, and day-to-day operations**
5. **To tell the user how to respond to accidents**

OBJECTIVE 6

**Match MSDS sections to the information each contains.**

✔ **NOTE:** Each organization can design its own MSDS form, and the sections may be in a different order than on the following list. However, each section must include all of the following information.

1. **Chemical name**—Identifies the substance and lists the date the MSDS was prepared, the name and address of the manufacturer, and usually a phone number for emergencies
2. **Hazardous ingredients/chemical identity**—Names the substances in the chemical that may be dangerous, provides safe exposure limits and common names for the chemical
3. **Physical characteristics**—Describes usual or safe physical qualities such as how it looks or smells, boiling and melting temperatures, evaporation rates, how easily it dissolves, and how heavy it is compared to water
4. **Fire and explosion data**—Identifies **flashpoint**, **flammability**, **combustibility**, and the best way to put out fire involving that chemical

KEY TERMS

**Flashpoint**—The lowest temperature at which a substance when heated will ignite

**Flammable**—Capable of igniting easily and burning or spreading rapidly

**Combustible**—Capable of bursting into flames at temperatures above 100°F

5. **Reactivity**—Describes what happens if this chemical comes in contact with certain conditions (e.g., heat) or chemicals (e.g., air, water, other chemicals)
6. **Health hazards**—Lists ways the chemical may enter your body, symptoms of overexposure, and emergency first aid procedures
7. **Usage, handling, and storage**—Describes how to clean up an accidental spill, leak, or release, including special precautions; tells how to handle, store, and dispose of the chemical safely
8. **Special protection and precautions**—Explains special personal protective equipment (PPE) to use when working with the chemical, and provides extra health and safety information not covered in other sections

**OBJECTIVE 7** **Match hazard placard and label symbols to their hazards.** (See Figure 3 through Figure 10 below and on the next page.)

1. **Corrosive**

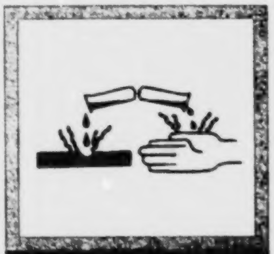


**Figure 3**
Corrosive

2. **Explosive**

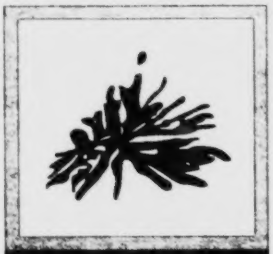


**Figure 4**
Explosive

3. **Flammable**

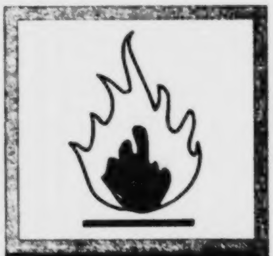


**Figure 5**
Flammable

4. **Harmful to foodstuffs**

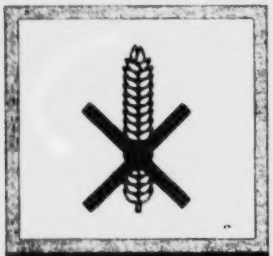


**Figure 6**
Harmful to foodstuffs

5. **Infectious**

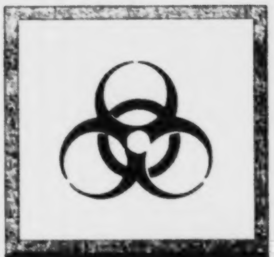


**Figure 7**
Infectious

6. **Oxidizing**

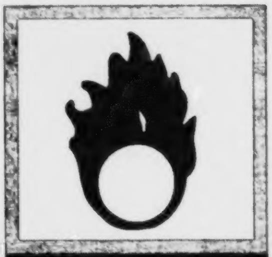


**Figure 8**
Oxidizing

7. **Poisonous**

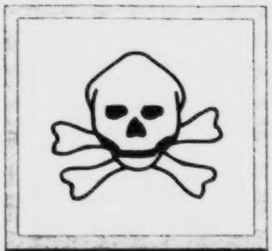


Figure 9
Poisonous

8. **Radioactive**

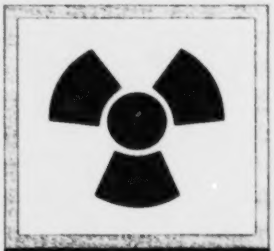


Figure 10
Radioactive

**OBJECTIVE 8** **Identify hazards using the NFPA 704 hazard triangle.**

✔ **NOTE:** This system is commonly used on chemical storage containers, as well as vehicles transporting hazardous materials. The diamonds are a quick way to identify how hazardous a chemical is. They are based on the coding system of the National Fire Protection Association (NFPA).

1. **The classification system consists of a large diamond made up of four smaller diamonds. Each diamond represents a different characteristic and is represented by a different color** (see Figure 11).

| Diamond Location | Characteristic | Diamond Color |
|---|---|---|
| Left-hand diamond | Health hazard | Blue |
| Top diamond | Fire hazard | Red |
| Right-hand diamond | Reactivity | Yellow |
| Bottom diamond | Special hazard | Black on white |

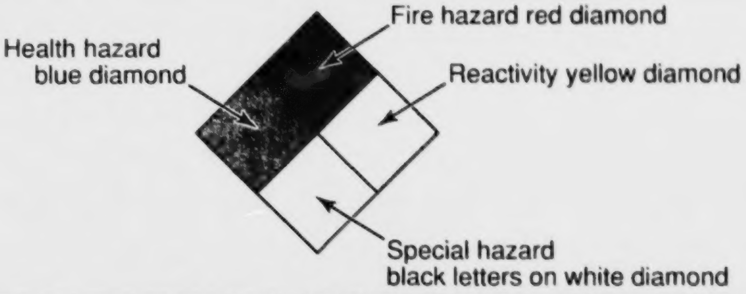

Fire hazard red diamond
Health hazard blue diamond
Reactivity yellow diamond
Special hazard black letters on white diamond

Figure 11
NFPA 704 hazard triangle

2. **Health, fire, and reactivity hazards are rated according to their severity on a scale of 0-4 with 0 meaning "no hazard" and 4 meaning "severe hazard"** (see Figure 12).

| Rating # | Health Hazard Meaning | Fire Hazard Meaning (Flash Points) | Reactivity Hazard Meaning |
|---|---|---|---|
| 4 | Deadly | Below 73¡F | May detonate |
| 3 | Extreme danger | Below 100¡F | Shock and heat may detonate |
| 2 | Hazardous | Below 200¡F | Violent chemical change |
| 1 | Slightly hazardous | Above 200¡F | Unstable if heated |
| 0 | Normal material | Will not burn | Stable |

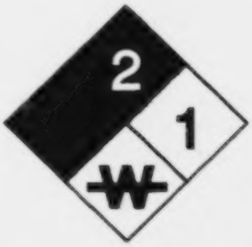
**Figure 12**
Health, fire, and reactivity hazards and ratings

3. **Other specific hazards are identified with abbreviations or symbols** (see Figure 13).

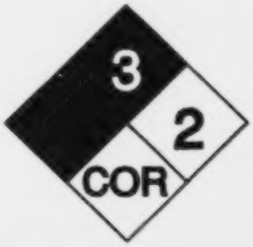
| Specific Hazard | Abbreviation or Symbol |
|---|---|
| Oxidizer | OXY |
| Acid | ACID |
| Alkali | ALK |
| Corrosive | COR |
| Use NO WATER | ~~W~~ |
| Radiation hazard | ☢ |

**Figure 13**
Other specific hazards and their abbreviations and symbols

Examples: Chemical #1



Chemical #2



Chemical #1 presents an extreme danger to your health, it will burn below 200°F, and it is unstable if heated. Do not use water on this chemical.

Chemical #2 is a corrosive that is hazardous to your health. It is very flammable with flash point below 100°F, and is capable of violent chemical change.

✔ **NOTE:** Remember—The greater the number, the greater the hazard.

OBJECTIVE 9

**Match methods by which hazardous materials can enter the body to their correct description.**

1. **Ingestion**—By mouth

   Example: Swallowing rubbing alcohol

2. **Absorption**—Through the skin

   Example: Getting some cleaning agents on your hands or skin

3. **Inhalation**—By breathing in gases, vapors, fumes, and other forms of a material

   Examples: Inhaling an anesthetic or smoke

OBJECTIVE 10

**Complete statements concerning the principles of body mechanics.**

1. **Using the body correctly results in coordination and endurance.**
2. **Good body mechanics prevent fatigue and injury, especially to the back.**
3. **Techniques for good body mechanics include maintaining good posture, lifting correctly, and moving correctly.**
4. **Maintaining good posture requires keeping the three natural curves of the back** (see Figure 14 on the next page) **in balance while standing, sitting, or lying down.**

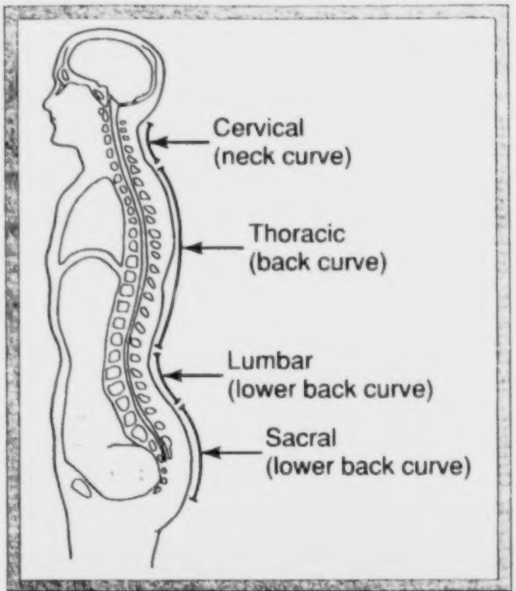


**Figure 14**
Spinal curves

- Correct standing posture
  - Align ears, shoulders, hips, knees, and ankles.
  - Keep shoulders relaxed and knees slightly bent.
  - Place feet slightly apart to improve balance.
  - Rest one foot on a footstool or rail to ease strain on your back when standing for an extended period.
  - Stand as close to the work area as possible to prevent reaching.
- Correct sitting posture
  - Align ears over shoulders and shoulders over hips.
  - Place **lumbar** roll or rolled up towel between your lower back and the back of nonadjustable chairs.

KEY TERM

**Lumbar**—Relating to the vertebrae (region) between the thoracic vertebrae and the sacrum

  - Adjust chair height and seat back firmness and angle as necessary.
  - Rest your buttocks against the chair back and keep your feet on the floor or footstool.

- Place your computer screen at eye height and at a comfortable distance from your eyes.
- Adjust the height of the work area as necessary.

- Correct lying (or sleeping) posture
  - Rest on your side with your knees slightly bent toward your chest (modified **fetal position**).

KEY TERM

**Fetal position**—Position in which the body lies on one side curled up with the arms and legs drawn up toward the chest and the head bowed forward

  - Rest on your back with a pillow placed under your knees.
  - Sleep with only one pillow under your head.

✔ **NOTE:** Sleeping with more than one pillow or too thick a pillow under your head exaggerates your neck curve and places undue stress on your back.

  - Choose a firm mattress.

- Moving correctly
  - Walk with your head up and your shoulders back.
  - Cushion and support your wrist and arm when using a computer keyboard and mouse.

✔ **NOTE:** There are all sorts of ergonomic mouse pads available today. One that many people find comfortable incorporates a gel wrist pad so that the user's hand is level with or above the mouse, thus relieving pressure on the carpal nerve and helping to prevent **carpal tunnel syndrome**. There are also many keyboard wrist rests.

KEY TERM

**Carpal tunnel syndrome**—Condition caused by compression of the nerve where it passes through the wrist into the hand; characterized by weakness, pain, and disturbances of sensation in the hand

  - Occasionally move and stretch your joints freely through entire range of motion.
  - Use carts, wheelchairs, bed sheets, or other devices to lift and carry objects whenever possible.

- **Pivot**, roll, or slide the object when a lifting or carrying device is not available.

KEY TERM

**Pivot**—To turn as if on a pin or shaft; to revolve

- Ask for help when you must carry a large object, and then ensure that you and your helper coordinate movements and carry the object on the same side of the body and at the same level.
- Use ladders rather than chairs or boxes to reach high objects.
- Avoid over-reaching or stretching to reach high objects.

■ Lifting correctly

- Determine whether or not you can lift the object alone or need help.
- Bend at your knees and hug the object close to you to maintain your back's correct alignment and your center of balance.
- Use your leg muscles, not your back muscles, for the actual lifting.
- Never turn or twist the body while lifting.

✔ **NOTE:** Make sure that your feet, knees, and torso are pointing in the same direction when lifting. Turn your feet *after* you have lifted the object.

OBJECTIVE 11

**List basic types of emergencies.**

✔ **NOTE:** Most emergencies should be handled by trained personnel. Know the extent of your responsibilities (your role) for each of the basic types of emergencies. Your job may be as simple as calling for help or as complex as aiding in evacuation and roll call.

1. **Fires**
2. **Mechanical failures**

   Examples: Loss of electricity, loss of heating or refrigeration system
3. **Bombs and bomb threats**
4. **Severe weather**

   Examples: Tornadoes, hurricanes, thunderstorms (lightning and wind)
5. **Natural disasters**

   Examples: Floods, earthquakes

6. **Accidents**

   Examples: Falls, cuts, burns, electrical shocks, poisoning, drowning, machinery entrapment

7. **Health problems**

   Examples: Heart attacks, strokes, seizures, heat exhaustion

OBJECTIVE 12

**During severe weather safety guidelines.**

***Before severe weather occurs***

1. **Know your organization's severe weather plan and your role in it.**
2. **Make sure that you know where to go in the event of severe weather.**
3. **Take part in the organization's periodic severe weather drills.**
4. **Know the location of the organization's emergency disaster supply kit, which should include a first-aid kit, battery powered radio and flashlight with extra batteries, canned food and can opener, and bottled water.**
5. **Learn where to get weather information, and the meaning of "watch" and "warning."**

KEY TERMS

**Watch**—Possibility of but no immediate danger; prepare to take shelter

**Warning**—Immediate danger; take shelter immediately

***During severe weather***

1. **When alarms, sirens, or warnings are issued by the local civil defense or national weather center, follow your severe weather plan.**
2. **Move quickly and quietly to your planned shelter:**
   - In nursing homes, hospitals, schools: Seek shelter on the lowest level and in the interior of the building, away from glass and outside openings.
   - In high-rise buildings: You may not have time to go to the lowest floor, so seek shelter in a hallway or small room in the interior of the building away from windows; do not use or seek shelter in an elevator.
3. **Do not seek shelter in dining halls, gyms, or other large rooms with wide-span roofs.**
4. **Make yourself as small as possible by crouching down.**
5. **Put your head down and cover it and your face with your arms.**

6. **Answer to roll call if at school.**
7. **Remain in designated area until the signal is given to return.**

OBJECTIVE 13

**Arrange in order the steps to follow on receiving a bomb threat.**

1. **When you answer the call, obtain as much information as you can about the caller, recording the call if possible.**

   Examples: Male, female, background noises, accent, voice characteristics

2. **Alert your instructor, supervisor, or building administrator.**
3. **Follow your building evacuation plan.**
4. **Do not return to the building until the "all clear" signal is given.**

OBJECTIVE 14

**Complete guidelines for general evacuation procedures in a fire emergency.**

✓ **NOTE:** Schools and hospitals hold routine fire evacuation drills. These drills must be taken with the utmost seriousness. Were a real fire to occur, students'/employees' knowledge of their responsibilities and proper evacuation routes could save their lives and that of others.

***Upon discovery of fire or smoke or upon activation of a smoke detector—***

1. **Close the doors around the fire to contain it, if doing so does not compromise your safety.**
2. **Do not attempt to extinguish or fight the fire unless you have been trained to do so.**
3. **Pull the nearest fire alarm.**

   ✓ **NOTE:** Fire alarms may be activated by smoke detectors, heat detectors, or pull stations (the "pull-to-activate-fire-alarm" boxes in the corridors). In buildings so equipped, activation of the fire suppression sprinklers may also activate the alarm system.

4. **Exit the building immediately according to evacuation plans.**
5. **Proceed to your designated meeting area and answer to roll call.**
6. **Dial 911 or local fire emergency number if in a rural area to notify the fire department of the fire and its exact location.**
7. **Notify the building administrator of the location of the fire.**

***At the sound of a fire alarm—***

1. **Shut down any machinery or processes in your area of responsibility.**

2. **Carefully feel several areas of any closed doors; if the door is hot, *do not open it.***

   ✔ **NOTE:** Opening the door provides oxygen that may immediately and dramatically increase the size and intensity of the fire.

3. **Check the exit path for smoke or fire; *do not enter smoke*.**

   ✔ **NOTE:** Smoke inhalation, not burns, is the number one cause of fire deaths. A person can become confused and disoriented by the carbon monoxide in smoke in a matter of seconds and die from smoke inhalation quickly thereafter.

4. **If the exit path is clear of smoke and fire, remain calm and immediately walk—do not run—to the nearest exit, and leave the building.**
5. **If you can smell but not see smoke, place a wet towel over your head and hold a wet cloth to your nose and mouth when exiting if possible.**
6. **To limit fire or smoke damage, close all doors and windows when leaving the room, if doing so does not compromise your own safety.**
7. **Close all hallway doors as you leave, if doing so does not compromise your own safety.**
8. **Assist disabled persons to a secure area—such as a stairwell—and inform responding fire department personnel of their location.**
9. **Assist visitors who are not familiar with evacuation routes.**
10. **Use the stairs, not the elevators.**

    ✔ **NOTE:** Heat or smoke can activate the elevator call system and stop the elevator on a fire floor. Additionally, fire personnel may need to use the elevators for fire or rescue operations.

11. **Leave the building in an orderly manner, and proceed to the designated meeting area.**
12. **Answer to roll call.**
13. **Report any hazardous conditions left in your work area to responding fire department personnel.**

    Examples: X-ray photographs, chemicals, oxygen equipment and storage tanks

14. **Keep walkways clear for emergency personnel/vehicles.**

**OBJECTIVE 15** **Describe the disabled person's fire evacuation responsibilities.**

***Pre-emergency responsibilities***

1. **Be familiar with your workplace buildings and their exits.**
2. **Know and share the safest method to use to assist you.**

3. **Know how many people you need to provide you with assistance.**
4. **Whenever possible, try to have a designated person or persons assist you during the evacuation.**
5. **Be prepared to explain how and where you need to be supported.**
6. **Practice instructions beforehand.**

***Evacuation responsibilities***

1. **Check the hallway for smoke and fire.**
2. **If the hallway is clear of smoke and fire—**
    - Go to the nearest stairwell.
    - Remain as close to the stairs as possible, without hindering the exit of others.
    - Do not use the elevators.
    - Have a previously designated person contact fire personnel for assistance.
3. **If there is smoke or flames in the hallway—**
    - Stay in the room with the doors closed.
    - Place wet clothing or towels at the bottom of the door if possible.

      ✔ **NOTE:** This helps prevent the spread of smoke into the room.
    - Call 911 and give the operator your exact location.
    - Place a wet cloth over your mouth and nose, if possible, and wait until someone arrives to assist you.

OBJECTIVE 16 **Identify the components of fire by labeling the sides of a fire tetrahedron.**

✔ **NOTE:** For many years the fire triangle (oxygen, fuel, and heat) was used to teach the components of fire. While this example is useful, it is not technically correct. Each of four components of the fire tetrahedron (see Figure 15 on the next page) must be in place for combustion to occur. If any one of the components is removed, the fire will be extinguished.

1. **Oxygen**
2. **Fuel**
3. **Heat**
4. **Chemical chain reaction**

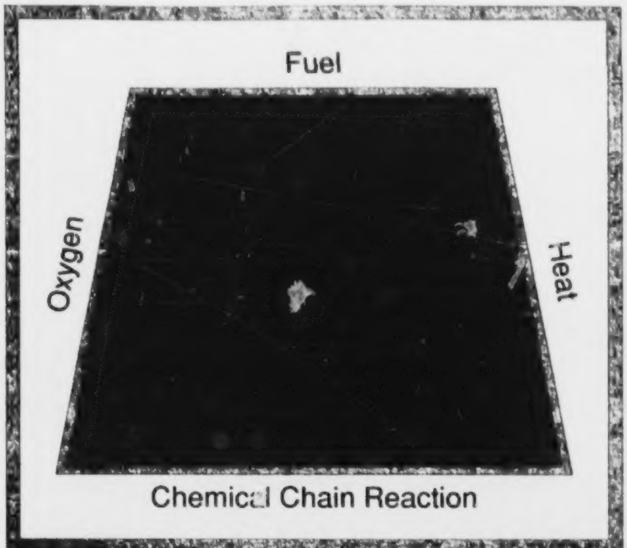


**Figure 15**
Fire tetrahedron

**OBJECTIVE 17** **Match fire classifications to their fuel sources.**

| Fire Class | Fuel Source | Fuel Classification |
|---|---|---|
| Class A | Wood, paper, rubber, plastic, trash, cotton bedding | Ordinary combustibles |
| Class B | Gasoline, oil, grease, gases (oxygen), paints, anesthetic agents | Flammable liquids |
| Class C | Live electrical equipment, wiring, appliances, motors | Electrical equipment |
| Class D | Combustible metals<br>Examples: Aluminum, magnesium, titanium, zirconium, sodium, potassium, lithium, calcium, zinc | Combustible metals<br>✔ **NOTE:** These fires are more common in industrial than in hospital settings. They require a special dry powder, Class D extinguisher. |

**Figure 16**
Fire classifications and fuel sources

OBJECTIVE 18

**Match fire extinguisher symbol shapes to fire classification letters.**

✔ **NOTE:** All portable fire extinguishers are labeled with picture and shape symbols. Each of the shape symbols contains the letter of the fire class for which the extinguisher is effective. Because speed is important when a fire is discovered, you should be able to glance at the symbols and know immediately whether the extinguisher is appropriate for the fire on hand.

1. **Class A**—Green triangle

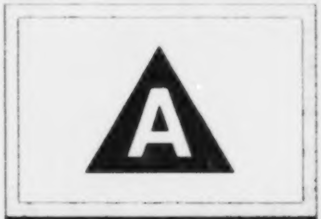


**Figure 17**
Class A Green triangle

2. **Class B**—Red square

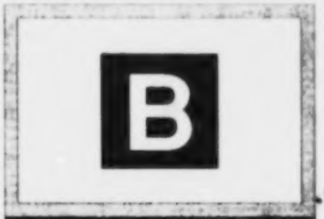


**Figure 18**
Class B Red square

3. **Class C**—Blue circle

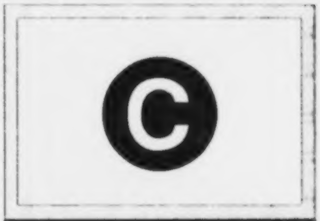


**Figure 19**
Class C Blue circle

4. **Class D**—Yellow star

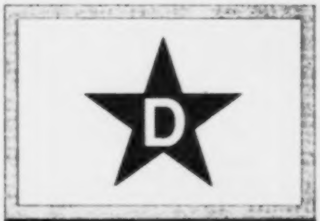


**Figure 20**
Class D Yellow star

OBJECTIVE 19

**Match extinguisher pictographs to the extinguisher's intended purposes** (see Figures 21 through Figure 26).

1. **Class A**—Ordinary combustibles

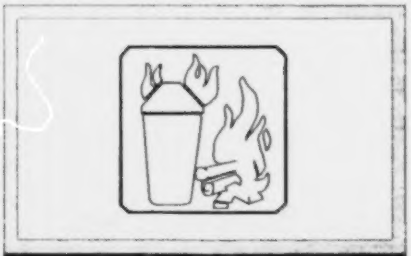


**Figure 21**
Class A Ordinary combustibles

2. **Class B**—Flammable liquids

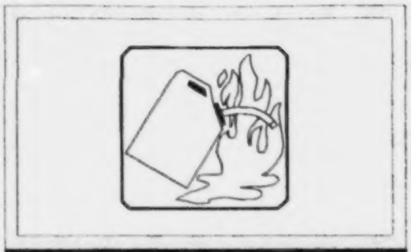


**Figure 22**
Class B Flammable liquids

3. **Class C**—Electrical equipment

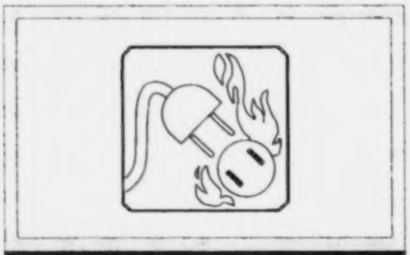


**Figure 23**
Class C Electrical equipment

4. **Class A fires but not Class B or C**

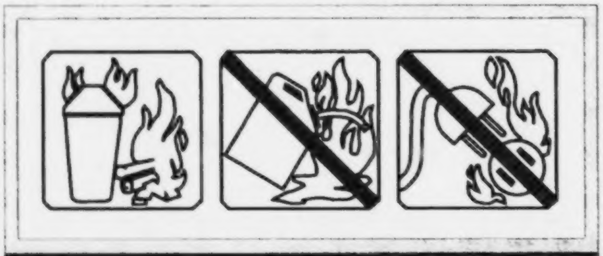


**Figure 24**
Class A fires but not Class B or C

5. **Class A and B fires but not Class C**

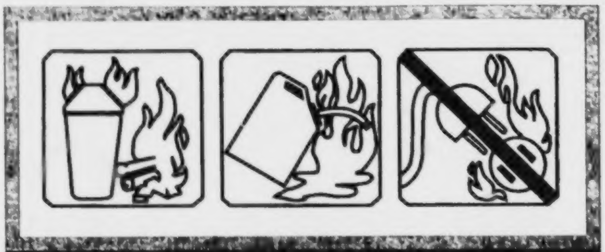


**Figure 25**
Class A and B fires but not Class C

6. **Class B and C fires but not Class A**

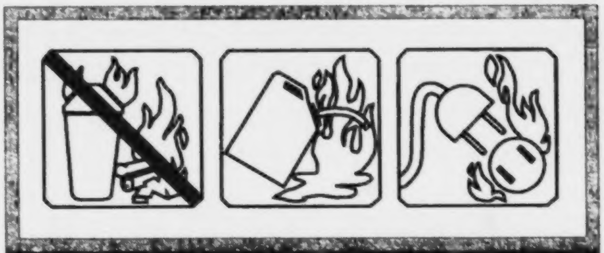


**Figure 26**
Class B and C fires but not Class A

**OBJECTIVE 20**

**List the characteristics of fires appropriate for handling with a portable fire extinguisher.**

1. **The fire is contained, as in a trash can, and is not spreading beyond the spot where it started.**
2. **The flames are not higher than the employee's head.**
3. **The heat from the fire does not prevent the employee from getting close enough to discharge the extinguisher within its effective range.**
4. **The size of the fire allows the employee to stand upright without experiencing radiated heat while discharging the extinguisher.**
5. **The fire cannot block the employee's only means of escape.**
6. **The employee can fight the fire with his or her back to an escape exit.**
7. **The fire is not producing a lot of smoke.**
8. **The fire is not near other fuels or hazardous materials that would cause it to grow suddenly or create an explosion.**

OBJECTIVE 21

**Arrange in order the general steps in using a fire extinguisher.**

✔ **NOTE:** Fighting even small fires presents risks. If you have not been trained to use a fire extinguisher or if the fire is not appropriate for handling with an extinguisher, *do not attempt to extinguish the fire.* Instead, pull the nearest fire alarm, evacuate the building, and get help immediately.

1. **Identify the fire class and then check the extinguisher label to make sure that the extinguisher is coded to put out that type of fire.**

2. **Pull the pin to break the inspection band** (see Figure 27).

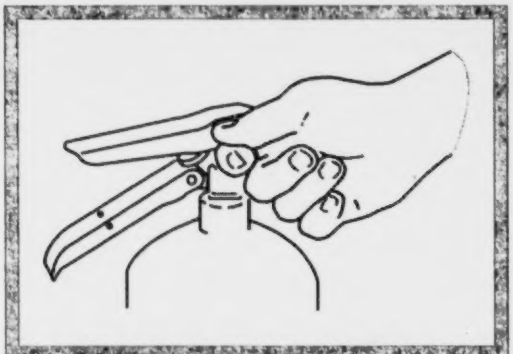


Figure 27
Step 2 Pull the pin

3. **Aim the extinguisher nozzle or horn at the base of the fire** (see Figure 28).

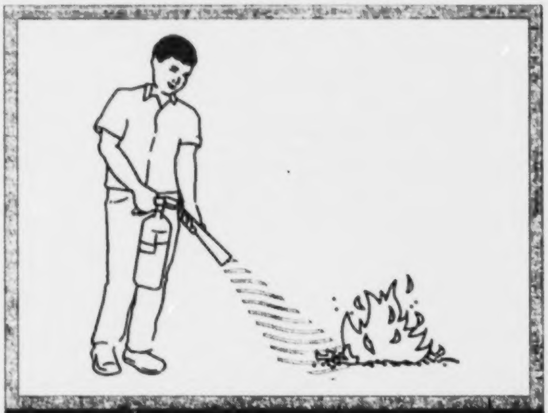


Figure 28
Step 3 Aim the extinguisher nozzle or horn

4. **Squeeze the handle to release the *extinguishing agent*** (see Figure 29).

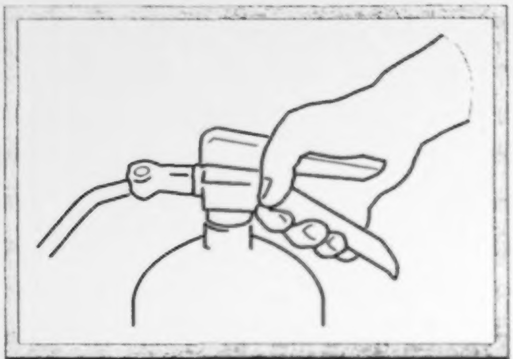


**Figure 29**
Step 4 Squeeze the handle

Key Term

**Extinguishing agent**—Substance used to put out a fire

Examples: Water, carbon dioxide, dry chemicals, halon, foam

5. **Sweep the nozzle from side to side until the fire appears to be out, repeating the process if fire breaks out again** (see Figure 30).

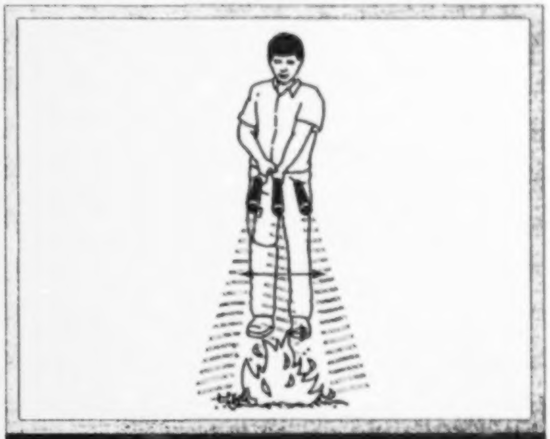


**Figure 30**
Step 5 Sweep the nozzle from side to side

✔ **NOTE:** One way to remember this sequence is to remember that the first letters of the steps spell "I PASS." Most portable extinguishers work according to these general directions. Always follow the directions printed on the model you are using.

**Objective 22** List fire prevention guidelines.

1. Keep equipment clean and in good operating condition.
2. Never overload electrical outlets.
3. Store flammables/combustibles in appropriate containers away from heat sources.
4. Keep heat sources away !rom flammables/combustibles.

   Example: Do not smoke near oxygen equipment.

5. Keep work and trash areas clean and free of debris.
6. Dispose of flammables according to established safety guidelines.
7. Never leave open flames unattended.
8. Use caution when using spark-producing equipment.
9. Report suspicious persons (possible arsonists) to security or supervisory personnel.
10. Keep fire exits unlocked.
11. Keep escape routes clear and well marked.
12. Know where fire alarm boxes are located.
13. Know where fire extinguishers are located and how to use them.
14. Always be on the lookout for fires or conditions that could cause fires or hinder escape and report them immediately.
15. Properly dispose of cigarettes and matches.
16. Smoke only on designated breaks and in designated areas.

**Objective 23** Complete statements concerning electrical safety.

✔ **NOTE:** Handle electrical equipment with care. All electrical equipment is potentially hazardous and can cause fires, explosions, shocks, burns, and even death.

1. Do not use any electrical appliance or equipment while you are touching metal or water.
2. Unplug electrical equipment before cleaning, inspecting, repairing, or removing anything from it.
3. Keep electrical equipment and work areas clean to prevent electrical fires.
4. Know that electrical sparks can ignite any nearby flammable materials.

5. **Keep access to *electrical panels*** (see Figure 31 below) **and *junction boxes* clear** (see Figure 32 below).

KEY TERMS

**Electrical panel**—Panel designed to display electrical wiring connections; usually placed inside the house

**Junction box**—Weatherproof enclosure designed to protect exterior electrical wiring connections

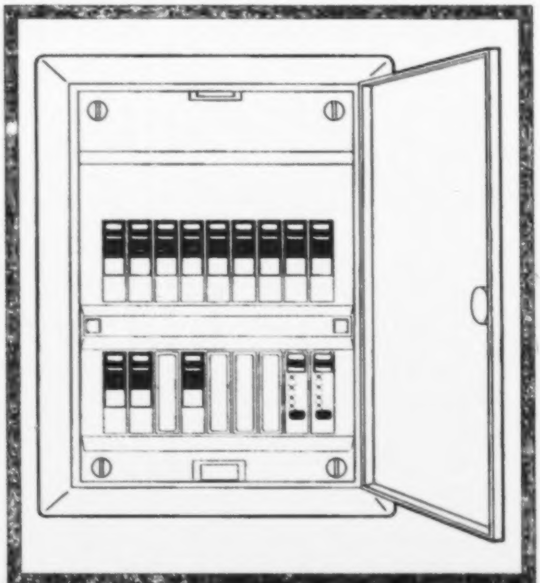


Figure 31
Electrical panel

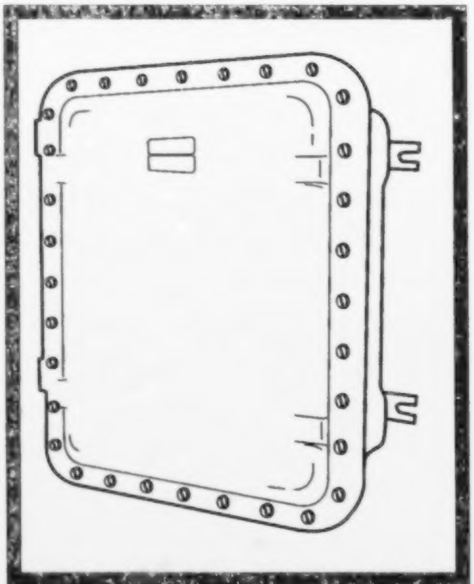


Figure 32
Junction box

6. **Keep flammable materials away from electrical heat sources, including lights.**

7. **Know the location of fuses and circuit breakers.**

KEY TERMS

**Fuse**—An electrical safety device consisting of a wire or strip of metal that melts and interrupts the circuit when the current exceeds a particular level

**Circuit breaker**—A device that shuts off a circuit when it becomes overloaded (too much current is flowing)

8. **Make sure all electrical equipment is properly *grounded*.**

KEY TERM

**Grounded**—Connected to earth or to an object that conducts electrical current to the earth

9. **Plug power tools into *grounded outlets* equipped with *ground fault circuit interrupters* (GFCI).**

✔ **NOTE:** Figure 33 below shows an old-fashioned two-hole outlet without a receptacle for a ground prong. Figure 34 below shows a typical grounded outlet for a three-prong plug; and Figure 35 on the next page shows a GFCI outlet. The GFCI looks the same as the three-hole grounded outlet but contains test/reset buttons. These are most common in bathrooms and in kitchens and other areas where water and electricity are used side by side and present a shock hazard.

KEY TERMS

**Grounded outlet**—Outlet that has a round receptacle for the ground prong on a plug; equipment is automatically grounded when plugged into such an outlet (see Figure 34 below)

**Ground fault circuit interrupter**—Device designed to protect against electric shock; should someone come in contact with "hot" wire or path to the ground the GFCI shuts the circuit in a fraction of a second, well before currents that are dangerous (see Figure 35)

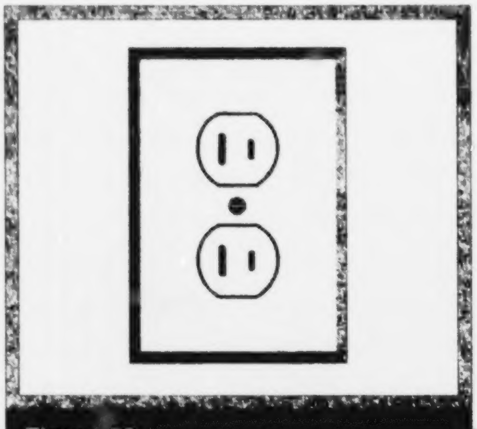


Figure 33
Old-fashioned two-hole outlet

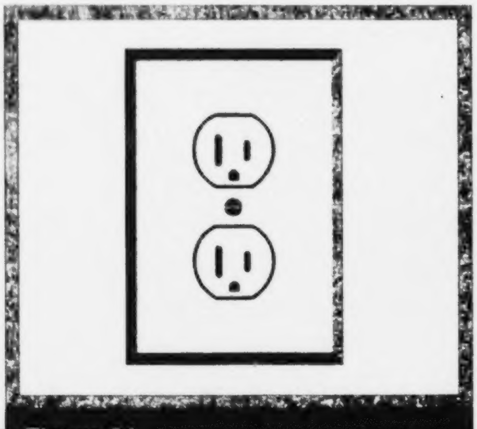


Figure 34
Grounded outlet for a three-prong plug

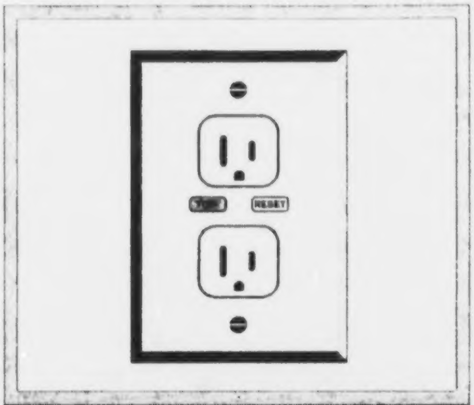


Figure 35
GFCI outlet

10. **Never use water on electrical fires.**

11. **Report any of the following unsafe conditions to your instructor or supervisor immediately and do not use:**

    - Defective, frayed, or damaged electrical cords
    - Shocking, sparking, overheating, or smoking equipment
    - Corroded or broken switches or outlets
    - Extension cords impermanent use

**OBJECTIVE 24** **Select true statements concerning basic equipment safety.**

1. **Remove rings and other jewelry when operating power equipment.**
2. **Secure long hair and loose clothing (e.g., ties, scarves, wide sleeves) when working with or near power equipment.**
3. **Wear personal protective equipment (safety goggles, gloves, etc.) as required.**
4. **Use equipment and tools only for their intended purposes.**
5. **Never use any equipment unless you are trained to do so.**
6. **Inspect equipment before each use; replace it or have it repaired by a qualified individual if parts are worn or damaged.**
7. **Disconnect the power from equipment before performing any maintenance tasks.**
8. **Make sure that power switches are turned to OFF before plugging or unplugging equipment.**

9. Never disconnect the power by pulling on the cord; instead, remove the plug from the outlet.

10. Make sure that your hands are dry before disconnecting equipment from its power source.

11. Keep electrical cords out of traffic areas.

12. Do not leave or store equipment in aisles or traffic lanes that could present a tripping hazard.

## Student Supplement 1—Guidelines for Interpreting Material Safety Data Sheets

Living in the modern world, you probably are aware that the use of chemicals offers convenience and progress at home and work. Naturally, you want to avoid dangerous overexposure to chemicals, especially on the job. Such overexposure is possible no matter where you work, even in an office or light industry.

Your company's hazard communications, or HazCom, program was created to protect your health and safety. Three important elements are at the heart of your HazCom program: warning labels on containers, training on the safe use and handling of chemicals, and material safety data sheets (MSDSs).

### What is on a MSDS

MSDSs are printed pages that give you all the critical information you need about how to use, transport, and store chemicals in order to protect yourself, as well as what to do in case of emergencies and overexposure. Information on MSDSs includes:

- The chemical's name or names
- Name, address, and phone number of the manufacturer
- List of the chemical's ingredients
- Permissible exposure limits (PEL) or threshold limit value (TLV)
- What conditions or other substances will cause the chemical to catch fire, explode, melt, or turn into dangerous gases
- How the chemical usually looks and smells
- How to put out a fire involving the chemical
- What to do if the chemical spills or leaks
- How to prevent dangerous exposure
- Health hazards such as skin irritant or cancer-causing agent
- Symptoms of overexposure
- What to do if you are overexposed
- When the MSDS was prepared

The information for each chemical's MSDS is put together by the manufacturer or distributor for that chemical. The sheets often look different from each other, but they still provide the same information. The law requires your employer to keep MSDSs up to date and to send the MSDS to your doctor or designated representative if you request it.

### Where the MSDS is kept

MSDSs must be readily accessible to employees—a posted sign may tell you where, and you can also find out by reading your company's written HazCom program. If you are not sure where to find MSDSs, your supervisor or your company's HazCom contact will make them available to you. It is the law.

### When to read a MSDS

You should always read the MSDS *before* you begin a job using a chemical. Even if you have used the chemical before, the manufacturer may have changed its formula, which may change the steps you should take to protect yourself. Taking proper precautions listed on the MSDS, such as wearing a respirator, can prevent serious long-term illnesses.

If you do not understand something on the MSDS, or have questions about your company's HazCom program, ask your supervisor or company contact. Your company knows that HazCom works best if you are fully informed and involved.

### How to read a MSDS

The material safety data sheet, or MSDS, is written information that can help protect you from overexposure to chemicals you find on the job. The MSDS is part of your company's hazard communications program. Each company can design its own MSDS form, and the sections may be in a different order. But, the basic kinds of information on any MSDS will be the same.

**Chemical name** (see Figure 1 on the next page). Lists the identity of the substance (the name on the label), date the MSDS was prepared, the name and address of the manufacturer, and usually a phone number for emergencies and more information.

**Hazardous ingredients/chemical identity** (see Figure 1 on the next page). Includes names of substances in the chemical that might be dangerous, and lists safety exposure limits such as permissible exposure limit or PEL (set by OSHA) or the threshold value limit or TVL. Also lists common names for the chemical.

**Physical characteristics** (see Figure 1 on the next page). Describes many physical qualities of the chemical, and lets you know what is usual or safe. For example, how the chemical looks and smells; boiling and melting temperatures (important in case a chemical might become a gas you could breathe); evaporation rate (known as *percent volatile*); how easily the chemical dissolves; and how heavy it is (this tells you if it will sink, float, or dissolve in water).

**Fire and explosion data** (see Figure 1 on the next page). Tells you the lowest temperature at which the chemical could catch fire (flash point). Lets you know if it is flammable (catches fire below 100°F) or combustible (catches fire above 100°F). Lists the best way to put out a fire involving that chemical.

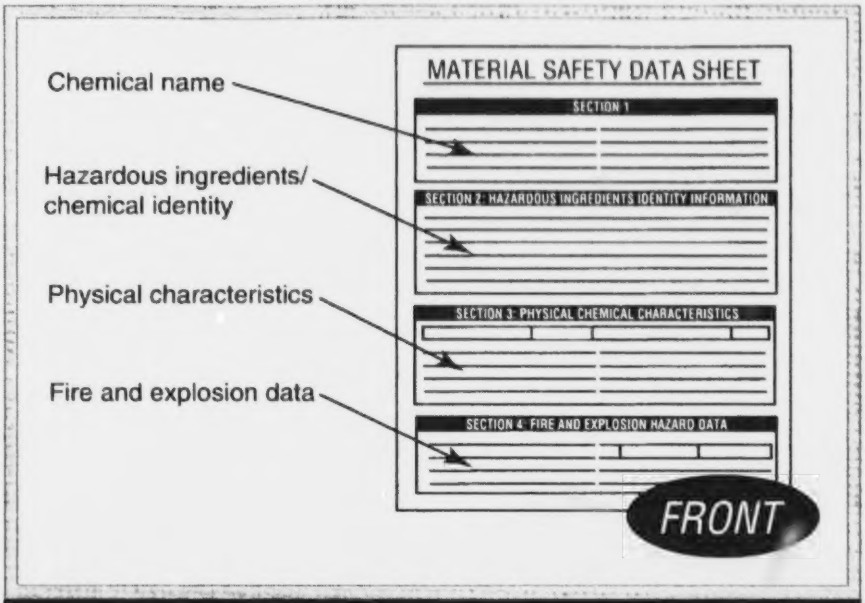

Chemical name
Hazardous ingredients/ chemical identity
Physical characteristics
Fire and explosion data
MATERIAL SAFETY DATA SHEET
SECTION 1
SECTION 2: HAZARDOUS INGREDIENTS IDENTITY INFORMATION
SECTION 3: PHYSICAL CHEMICAL CHARACTERISTICS
SECTION 4: FIRE AND EXPLOSION HAZARD DATA
FRONT

Figure 1

**Reactivity** (see Figure 2 on the next page).Describes what happens if this chemical comes in contact with air, water, or other chemicals. Describes conditions (like heat) or materials (like water) that can cause the chemical to react by burning, exploding, or releasing dangerous vapors. The chemical is called "incompatible" or "unstable" with these conditions or substances.

**Health hazards** (see Figure 2 on the next page). Lists ways the chemical might enter your body, like splashing on your skin or being breathed in as vapor, as well as possible symptoms of overexposure. Lets you know if overexposure might make existing medical conditions worse, and describes emergency first-aid procedures.

**Usage, handling, and storage** (see Figure 2 on the next page). Describes how to clean up an accidental spill, leak, or release, including special procedures. Tells you how to handle, store, and dispose of chemicals safely. Remember, if there is an accident, notify your supervisor immediately. Take care of it yourself only if you are trained to do so and are wearing the proper equipment.

**Special protection and precautions** (see Figure 2 on the next page). Explains special personal protective equipment (PPE) and other equipment to use when working with the chemical, special procedures, extra health or safety information, signs that should be posted, and other information not covered in other sections.

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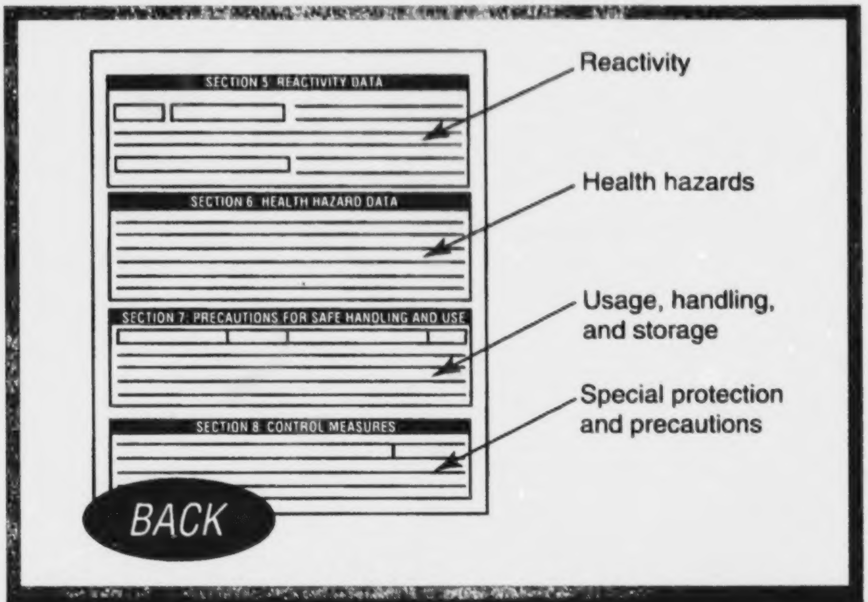
SECTION 5: REACTIVITY DATA
SECTION 6: HEALTH HAZARD DATA
SECTION 7: PRECAUTIONS FOR SAFE HANDLING AND USE
SECTION 8: CONTROL MEASURES
BACK
Reactivity
Health hazards
Usage, handling, and storage
Special protection and precautions

Figure 2

**Terms and abbreviations used on MSDSs**

The following terms and abbreviations will help you interpret material safety data sheets.

- **TLV**—Threshold limit value; a time-weighted average concentration *under which* most people can work consistently for 8 hours a day, day after day with no harmful effects
- **Ceiling**—Uppermost limit
- **ACGIH**—American Conference of Governmental Industrial Hygienists
- **OSHA**—Occupational Safety and Health Act
- **PEL**—Permissible exposure limit; the maximum time-weighted concentration *at which* 95 percent of exposed, healthy adults suffer no adverse effects over a 40-hour week
- **ppm**—Parts per million
- **STEL**—Short-time exposure limit; a 15-minute, time-weighted average that should not be exceeded at any time during a workday. Exposures at STEL should not be longer than 15 minutes and should not be repeated more than four times a day with at least 60 minutes between exposures
- **IDLH**—Immediately dangerous to life and health; material *at* or *above* this level poses an immediate hazard to life or produces immediate, irreversible, debilitating effects
- **LEL**—Lower explosive limit; below the flammability range (too lean to burn)
- **UEL**—Upper exposure limit; above the flammability range (too rich to burn)

## Student Supplement 2—Tornado Tips

### Tornado Tips

**Tornado**—Violent rotating column of air in contact with the ground. It has many faces: cone-shaped, rotating mass of debris at the surface with no visible connection to the cloud; dark seething cloud on the ground.

**Look and listen for the following signs.**

- Series of pouches projecting downward from the storm's base
- Large hail, heavy rain, strong winds
- Intense, frequent lightning
- Loud roar like the sound of a jet or train
- Rotating cloud of debris or dust near the ground
- Bulge or pendent with organized rotary motion at the base of a thunderstorm
- Characteristics of the "typical" tornado

  Time: 7:39 p.m. DST
  Path: 5½ miles
  Width: 500 feet
  Area: 1 square mile

**Perform the following safety procedures.**

- Seek inside shelter—leave vehicles.
- Avoid windows, doors, and outside walls.
- Protect head and chest; crouch with your face to floor and hands clasped behind your head.
- Home—go to shelter, basement, or first-floor, interior small room, bathroom, closet, or hall and get under sturdy furniture, a mattress, or in a tub.
- Schools, offices—go to designated shelter (interior rooms or hallways or lowest floor); avoid places with wide-span roofs such as auditoriums, gymnasiums, and cafeterias; avoid halls that open to the south or west; avoid south or west walls.
- Mobile homes or vehicles—evacuate to substantial structure, ditch, culvert, or ravine.

- Be sure everyone is familiar with your safety plan; have a portable TV/radio and flashlight in your shelter area.

**Learn the meanings of terms used to describe tornadic conditions.**

*Tornado warning—*

- Tornado has been reported or indicated by Doppler radar!
- Take cover immediately if in or near the warning area.

*Tornado watch—*

- Conditions favor tornado development.
- Make preliminary plans.
- Watch for threatening conditions.
- Listen to a TV/radio so that you will know if the watch turns to a warning.

**OBJECTIVE 25**

## Assignment Sheet 1—Subscribe to a Safety Pledge

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Form is signed and dated by student ______
- Form is signed and dated by parent or guardian ______

**Overall rating** ______

Evaluator's comments ________________________________________

________________________________________________________

________________________________________________________

**EXERCISE**

**DIRECTIONS** Read the safety pledge on the next page and then sign and date it if you agree to follow it. Have your parent or guardian sign the safety pledge if you are under their supervision.

## SAFETY PLEDGE

______________________________, who is a student enrolled in surgical technology, will be in contact with surgical supplies and materials, power equipment, hazardous materials, and some physical dangers involving lifting and moving.

This student will receive instruction about safety and correct procedures to follow to protect him/her from danger. The student must assume responsibility for safe practices, and we therefore ask that he/she subscribe to the following safety pledge:

- I AGREE TO ABIDE BY ALL OF THE SAFETY RULES IN THE SURGICAL TECHNOLOGY CLASSROOM/CLINICAL TEACHING FACILITY AND WILL MAINTAIN PROFESSIONAL CONDUCT IN KEEPING WITH THIS PROFESSION.
- I PLEDGE THAT I WILL TAKE PROPER CARE OF ANY EQUIPMENT THAT IS ISSUED TO ME OR THAT I USE IN CLASS/CLINICAL WORK, AND I AGREE TO RETURN IT TO ITS PROPER STORAGE LOCATION.
- I WILL IMMEDIATELY REPORT TO MY INSTRUCTOR/SUPERVISOR ANY UNSAFE SITUATIONS, EQUIPMENT, OR ACCIDENTS.

**Student's Signature** ______________________ **Date** __________

- I HEREBY GIVE CONSENT TO ALLOW MY DAUGHTER/SON/WARD TO OPERATE ALL EQUIPMENT NECESSARY IN CARRYING OUT THE REQUIREMENTS OF THE COURSE.

**Parent's or Guardian's Signature** ______________ **Date** __________

**OBJECTIVE 26**

## Assignment Sheet 2—Complete an Accident Report Form

Name ______________________ Date ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Form is complete and accurate | _____ |
| • Form is neat and legible | _____ |
| • Form is signed and dated by student | _____ |
| **Overall rating** | _____ |

Evaluator's comments ______________________________

______________________________

______________________________

**EXERCISE**

**DIRECTIONS** Read the following scenario. Answer the questions assuming that you are the surgical technologist in the scenario. Complete the accident report form given to you by your instructor using the current date and your own personal information for home address, telephone, etc.

**SCENARIO** It is 3 PM and the end of your shift. You have just finished assisting with a long, complicated operation. You are tired, as you gather up the tissue and blood specimens that you have been asked to deliver to the medical center lab.

On the way to the lab, you round a corner incautiously and bump into June A. Verschoe, a 34-year-old hospital visitor. You both fall on impact, and the specimens fly out of your hands and break. Small bits of glass from a broken specimen container embed in your right forearm and elbow and also in June's left calf. June is more embarrassed than hurt. She brushes the accident off as minor and asks to be directed to the women's room so that she can clean up before visiting the patient she has come to see.

1. Is this a minor accident as June describes? Why or why not?

______________________________

______________________________

______________________________

2. Do you let June continue to the women's room and then to her patient? Why or why not?

3. List the immediate steps you would take in this accident.

4. Complete the accident report form provided by your instructor.

OBJECTIVE 27

## Assignment Sheet 3—Interpret Material Safety Data Sheets

Name ______________________ Date ____________

**Evaluation criteria** **Rating**

- Directions have been followed ______
- All questions have been answered correctly ______

**Overall rating** ______

Evaluator's comments ______________________

EXERCISE

DIRECTIONS

Read the MSDSs at the end of this assignment and use them to answer the following questions.

**MSDS 1—Hydrogen Peroxide (45%-59.5%)** (see pages 51 through 58)

1. What special hazard is posed by this product? ______________________
2. What is this product used for? ______________________
3. What company manufactures this product? ______________________
4. What general health effects can this product have? ______________________
5. What first aid measures should you take if you spill some 45%—59.5% hydrogen peroxide on your skin? ______________________
6. How should this product be stored? ______________________

931

7. Is this product combustible? Explosive? ____________________

8. Is this product considered a human carcinogen? ____________________

9. What DOT placard would be affixed to containers of this product? ____________________

____________________

10. Aside from sterilization procedures, what other applications could this product have?

____________________

**MSDS 2—CIDEX®OPA Solution** (see pages 59 through 63)

1. What is this product used for? ____________________

2. Who manufactures this product? ____________________

3. Why is the Composition and Ingredients Section for this product not applicable?

____________________

4. How hazardous is this product? ____________________

5. How should you protect your hands when cleaning up a spill of this product?

____________________

6. What color is this product? ____________________

7. What medical conditions can be aggravated by exposure to this product?

____________________

**MSDS 3—Institutional Formula Drano** (see pages 65 through 68)

1. What are the two main ingredients in this product? ____________________

2. What are the potential health effects of this product? ____________________

____________________

____________________

____________________

3. What first aid measures should you take if you accidentally ingest some of this product?

____________________

4. What PPE should you don when using this product? ______________________

_____________________________________________

_____________________________________________

5. What does this product smell like? ______________________

ASP **MATERIAL SAFETY DATA SHEET**

## HYDROGEN PEROXIDE (45% - 59.5%)

**MSDS: 001**
EFFECTIVE: 12/18/98
REVISION: A
CR8432

FOR PRODUCT ASSISTANCE CONTACT ADVANCED STERILIZATION PRODUCTS - (800) 755-5900
EMERGENCY TELEPHONE NUMBERS: CHEMTREC (800) 262-8200

**Advanced Sterilization Products**
**a Johnson & Johnson Company**
**33 Technology Drive**
**Irvine, CA 92618-2346**

### 1. CHEMICAL PRODUCT/COMPANY IDENTIFICATION

| | |
|---|---|
| PRODUCT NAME: | HYDROGEN PEROXIDE |
| SYNONYMS: | HYDROGEN PEROXIDE SOLUTION (DOT), PERHYDROL, PEROSSIDO DI IDROGENO (ITALIAN), PEROXYDE D'HYDROGENE (FRENCH), WASSERTOFFPEROXID (GERMAN) AND WATER-STOFPEROXIDE (DUTCH) |

| | | |
|---|---|---|
| HMIS HAZARD RATINGS: | HEALTH (BLUE): | 2 |
| | REACTIVITY (YELLOW): | 2 |
| | FLAMMABILITY (RED): | 0 |
| | SPECIAL HAZARD (WHITE): | OXIDIZER, CORROSIVE |

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

| | | |
|---|---|---|
| CAS# AND COMPONENTS: | MATERIAL/COMPONENT: | HYDROGEN PEROXIDE |
| | PERCENT: | 45 TO 59.5% |
| | CAS# | 7722-84-1 |
| | MATERIAL/COMPONENT: | WATER |
| | PERCENT: | 55 TO 40.5% |
| | CAS# | 7732-18-5 |

### 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:**
OXIDIZER. CONTACT WITH COMBUSTIBLES MAY CAUSE FIRE. DECOMPOSES YIELDING OXYGEN THAT SUPPORTS COMBUSTION OF ORGANIC MATTERS AND CAN CAUSE OVERPRESSURE IF CONFINED.

**HEALTH EFFECTS:**
CORROSIVE TO EYES, SKIN, NOSE, THROAT, AND LUNGS. MAY CAUSE IRREVERSIBLE TISSUE DAMAGE TO THE EYES INCLUDING BLINDNESS.

### 4. FIRST AID MEASURES

| | |
|---|---|
| EYES: | IMMEDIATELY FLUSH WITH LARGE AMOUNTS OF WATER FOR AT LEAST 15 MINUTES, LIFTING UPPER AND LOWER LIDS INTERMITTENTLY. SEE PHYSICIAN OR OPHTHALMOLOGIST. |
| SKIN: | WASH WITH LARGE AMOUNTS OF WATER. IF IRRITATION OCCURS, SEE A PHYSICIAN. |
| INHALATION: | REMOVE TO FRESH AIR. IF BREATHING IS DIFFICULT OR DISCOMFORT OCCURS, CALL A PHYSICIAN. |
| INGESTION: | DO NOT INDUCE VOMITING. CALL PHYSICIAN OR YOUR LOCAL POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. |

**NOTES TO PHYSICIAN:**
HYDROGEN PEROXIDE AT THESE CONCENTRATIONS IS A STRONG OXIDANT. DIRECT CONTACT WITH THE EYE IS LIKELY TO CAUSE CORNEAL DAMAGE ESPECIALLY IF NOT WASHED IMMEDIATELY. CAREFUL OPHTHALMOLOGIC EVALUATION IS RECOMMENDED AND THE POSSIBILITY OF LOCAL CORTICOSTEROID THERAPY SHOULD BE CONSIDERED. BECAUSE OF THE LIKELIHOOD OF SYSTEMIC EFFECTS, ATTEMPTS AT EVACUATING THE STOMACH VIA EMESIS INDUCTION OF GASTRIC LAVAGE SHOULD BE AVOIDED. THERE IS REMOTE POSSIBILITY, HOWEVER, THAT A NASOGASTRIC OR OROGASTRIC TUBE MAY BE REQUIRED FOR THE REDUCTION OF SEVERE DISTENSION DUE TO GAS FORMATION.

## 5. FIRE FIGHTING MEASURES

**EXTINGUISHING MEDIA:**
PREFERABLY WATER OR WATER FOG. CARBON DIOXIDE AND DRY CHEMICAL MAY ALSO BE USED.

**SPECIAL FIRE FIGHTING PROCEDURES:**
ANY TANK OR CONTAINER SURROUNDED BY FIRE SHOULD BE FLOODED WITH WATER FOR COOLING. WEAR FULL PROTECTIVE CLOTHING AND SELF-CONTAINED BREATHING APPARATUS.

**DEGREE OF FIRE AND EXPLOSION HAZARD:**
PRODUCT IS NONCOMBUSTIBLE. ON DECOMPOSITION H2O2 RELEASES OXYGEN WHICH MAY INTENSIFY FIRE.

**HAZARDOUS DECOMPOSITION PRODUCTS:**
OXYGEN WHICH SUPPORTS COMBUSTION.

## 6. ACCIDENTAL RELEASE MEASURES

**PROCEDURE FOR RELEASE OR SPILL:**
DILUTE WITH LARGE VOLUME OF WATER AND HOLD IN A POND OR DIKED AREA UNTIL H2O2 DECOMPOSES. DISPOSE ACCORDING TO METHODS OUTLINED FOR WASTE DISPOSAL.

## 7. HANDLING AND STORAGE

WEAR CUP TYPE CHEMICAL SAFETY GOGGLES AND/OR FULL FACE SHIELD, POLYESTER OR ACRYLIC FULL COVER CLOTHING AND RUBBER OR NEOPRENE GLOVES AND SHOES. AVOID COTTON, WOOL, AND LEATHER. AVOID EXCESSIVE HEAT AND CONTAMINATION. CONTAMINATION MAY CAUSE DECOMPOSITION AND GENERATION OF OXYGEN GAS WHICH COULD RESULT IN HIGH PRESSURES AND POSSIBLE CONTAINER RUPTURE. HYDROGEN PEROXIDE SHOULD BE STORED ONLY IN VENTED CONTAINERS AND SHOULD BE TRANSFERRED ONLY IN A PRESCRIBED MANNER. NEVER RETURN UNUSED HYDROGEN PEROXIDE TO ORIGINAL CONTAINER. EMPTY DRUMS SHOULD BE TRIPLE RINSED WITH WATER BEFORE DISCARDING. UTENSILS USED FOR HANDLING HYDROGEN PEROXIDE SHOULD BE MADE ONLY OF GLASS, STAINLESS STEEL, ALUMINUM, OR PLASTIC.

**VENTILATION:**
PROVIDE MECHANICAL GENERAL AND/OR LOCAL EXHAUST VENTILATION TO PREVENT RELEASE OF VAPOR OR MIST INTO THE WORK ENVIRONMENT.

**STORAGE:**
STORE DRUMS IN COOL AREAS OUT OF DIRECT SUNLIGHT AND AWAY FROM COMBUSTIBLES.

**MATERIAL SAFETY DATA SHEET**

## HYDROGEN PEROXIDE (45% - 59.5%)

**MSDS: 001**
EFFECTIVE: 12/18/98
REVISION: A
CR8432

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

VENTILATION SHOULD BE PROVIDED TO MINIMIZE THE RELEASE OF H2O2 VAPORS AND MIST INTO THE WORK ENVIRONMENT. SPILLS SHOULD BE COLLECTED OR CONFINED IMMEDIATELY AND DILUTED FOR DISPOSAL TO PREVENT RELEASE INTO THE WORK AREA. REMOVE CONTAMINATED CLOTHING IMMEDIATELY AND WASH BEFORE REUSE.

**RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT:**

**RESPIRATORY:**
IF CONCENTRATIONS IN EXCESS OF 10 PPM ARE EXPECTED USE APPROVED SELF-CONTAINED BREATHING APPARATUS. DO NOT USE OXIDIZABLE SORBANTS SUCH AS ACTIVATED CARBON.

**EYES:**
USE CUP TYPE CHEMICAL GOGGLES AND/OR FULL FACE SHIELD.

**GLOVES:**
LIQUID PROOF RUBBER OR NEOPRENE GLOVES.

**SPECIAL CLOTHING AND EQUIPMENT:**
POLYESTER OR ACRYLIC FULL CLOTHING. (AVOID COTTON, WOOL, AND LEATHER)

**FOOTWEAR:**
RUBBER OR NEOPRENE FOOTWEAR. (AVOID LEATHER)

### 9. PHYSICAL AND CHEMICAL PROPERTIES

| | 40% | 60% |
|---|---|---|
| MELTING/FREEZING POINT: | –41.4°C (–42.5°F) | –52°C (–62°F) |
| BOILING POINT: | 110°C (229°F) | 114°C (237°F) |
| VAPOR PRESSURE: | 22 MM HG @ 30°C | 18.3 MM HG @ 30°C |
| VAPOR DENSITY (AIR=1): | NO DATA | NO DATA |
| APPEARANCE AND STATE (ROOM TEMP.) | <-------------CLEAR TO COLORLESS-------------> | |
| ODOR: | <---------------------ODORLESS--------------------> | |
| SPECIFIC GRAVITY (H2O=1:) | 1.15 @ 20C/4C | 1.19 @ 20C/4C |
| SOLUBILITY IN H2O % BY WT: | <--------------------------100%--------------------------> | |
| % VOLATILES: | <--------------------------100%--------------------------> | |
| EVAPORATION RATE (BUTYL ACETATE=1) | <-----------------------ABOVE 1----------------------> | |
| pH (AS IS): | <------------------------1.0 - 3.0------------------------> | |
| pH (1% SOLUTION): | <------------------------5.0 - 6.0------------------------> | |
| ODOR THRESHOLD: | <------ -----------NOT AVAILABLE-------------------> | |
| PARTITION COEFFICIENT (N-OCTANO/WATER): | <------------------NOT AVAILABLE-------------------> | |
| FLASH POINT: | <---------------NON COMBUSTIBLE----------------> | |
| AUTOIGNITION TEMPERATURE: | <---------------NON COMBUSTIBLE----------------> | |
| FLAMMABLE LIMITS (AIR) UPPER: | <---------------NON COMBUSTIBLE----------------> | |
| LOWER: | <---------------NON COMBUSTIBLE----------------> | |
| EXPLOSIVE PROPERTIES: | <-----------------NOT APPLICABLE-----------------> | |
| OXIDIZING PROPERTIES: | STRONG OXIDIZER | |
| SOLUBILITY — FAT SOLUBILITY (SOLBENT — OIL) | NO DATA AVAILABLE | |

### 10. STABILITY AND REACTIVITY

| | |
|---|---|
| STABILITY: | STABLE UNDER NORMAL CONDITIONS |
| HAZARDOUS POLYMERIZATION: | WILL NOT OCCUR |
| CONDITIONS TO AVOID: | EXCESSIVE HEAT OR CONTAMINATION COULD CAUSE PRODUCT TO BECOME UNSTABLE AND DECOMPOSE. |

MATERIALS TO AVOID: DIRT, ORGANICS, CYANIDES, AND COMBUSTIBLES SUCH AS WOOD, PAPER, OILS, ETC.

MAJOR CONTAMINANTS THAT CONTRIBUTE TO INSTABILITY:
IRON AND OTHER HEAVY METALS, COPPER ALLOYS AND CAUSTIC.

INCOMPATIBILITY: REDUCING AGENTS, WOOD, PAPER, AND OTHER COMBUSTIBLES (SEE ABOVE)

HAZARDOUS DECOMPOSITION PRODUCTS: OXYGEN THAT SUPPORTS COMBUSTION

SENSITIVITY TO MECHANICAL IMPACT: NO DATA AVAILABLE
SENSITIVITY TO STATIC DISCHARGE: NO DATA AVAILABLE

## 11. TOXICOLOGICAL INFORMATION

| | |
|---|---|
| EYE CONTACT: | SEVERE IRRITANT/CORROSIVE (RABBIT) (70% $H_2O_2$) REF. ICG/T-79.027 |
| SKIN CONTACT: | SEVERE IRRITANT/CORROSIVE (RABBIT) (50% $H_2O_2$) REF. I89-1079 |
| SKIN ABSORPTION: | LD50>6.5 G/KG (RABBIT) (70% $H_2O_2$) REF. ICG/T-79.027 |
| INHALATION: | LC50>0.17 MG/L (RAT) (50% $H_2O_2$) REF. I89-1080 |
| INGESTION: | LD50>225 MG/KG AND <1200 MG/KG (RAT) (50% $H_2O_2$) REF. I86-914 |

**ACUTE EFFECTS FROM OVEREXPOSURE:**
SEVERE IRRITANT/CORROSIVE TO EYES, SKIN, AND GASTROINTESTINAL TRACT. MAY CAUSE IRREVERSIBLE TISSUE DAMAGE TO THE EYES, INCLUDING BLINDNESS. INHALATION OF MIST OR VAPORS MAY BE SEVERELY IRRITATING TO NOSE, THROAT, AND LUNGS.

**CHRONIC EFFECTS FROM OVEREXPOSURE: (EFFECTS CONSIDERED INCLUDE: SENSITIVITIES, CARCINOGENICITY, TERATOGENICITY, MUTAGENICITY, SYNERGISTIC PRODUCTS, AND ANY MEDICAL CONDITIONS GENERALLY RECOGNIZED AS BEING AGGRAVATED BY EXPOSURE.)**
THERE ARE REPORTS OF LIMITED EVIDENCE OF CARCINOGENICITY OF HYDROGEN PEROXIDE TO MICE ADMINISTERED HIGH CONCENTRATIONS IN THEIR DRINKING WATER (IARC ONOGRAPH 36,1985). HOWEVER, THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER CONCLUDED THAT HYDROGEN PEROXIDE COULD NOT BE CLASSIFIED AS TO ITS CARCINOGENICITY TO HUMANS (GROUP III CARCINOGEN).

## 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL FATE:
$H_2O_2$ IN THE AQUATIC ENVIRONMENT IS SUBJECT TO VARIOUS REDUCTION OR OXIDATION PROCESSES AND DECOMPOSES INTO WATER AND OXYGEN. $H_2O_2$ HALF LIFE IN FRESHWATER RANGED FROM 8 HOURS TO 20 DAYS, IN AIR FROM 10-20 HOURS AND IN SOILS FROM MINUTES TO HOURS DEPENDING UPON MICROBIOLOGICAL ACTIVITY AND METAL CONTAMINANTS.

| ENVIRONMENTAL EFFECTS: | | |
|---|---|---|
| | CHANNEL CATFISH | 96 HR LC50 = 37.4 MG/L |
| | FATHEAD MINNOW | 96 HR LC50 = 16.4 MG/L |
| | DAPHNIA MAGNA | 24 HR LC50 = 7.7 MG/L |
| | DAPHNIA PULE | 48 HR LC50 = 2.4 MG/L |
| | PHYSA SP.<br>(FRESHWATER SNAIL) | 96 HR LC50 = 17.7 MG/L |

FOR MORE INFORMATION REFER TO ECETOC "JOINT ASSESSMENT OF COMMODITY CHEMICALS NO. 22, HYDROGEN PEROXIDE." ISSN-0773-6339, JANUARY 1993.

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**MATERIAL SAFETY DATA SHEET**

## HYDROGEN PEROXIDE (45% - 59.5%)

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### 13. DISPOSAL CONSIDERATIONS

**WASTE DISPOSAL METHOD:**

AN ACCEPTABLE METHOD OF DISPOSAL IS TO DILUTE WITH A LARGE AMOUNT OF WATER AND ALLOW THE HYDROGEN PEROXIDE TO DECOMPOSE FOLLOWED BY DISCHARGE INTO A SUITABLE TREATMENT SYSTEM IN ACCORDANCE WITH ALL REGULATORY AGENCIES. BECAUSE ACCEPTABLE METHODS OF DISPOSAL MAY VARY BY LOCATION AND BECAUSE REGULATORY REQUIREMENTS MAY CHANGE, THE APPROPRIATE REGULATORY AGENCIES SHOULD BE CONTACTED PRIOR TO DISPOSAL.

### 14. TRANSPORT INFORMATION

**DOT PROPER SHIPPING NAME:**

HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS WITH MORE THAN 40 PERCENT BUT NOT MORE THAN 60 PERCENT HYDROGEN PEROXIDE.

| | |
|---|---|
| IATA: | HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS WITH MORE THAN 40 BUT NOT MORE THAN 60 PERCENT HYDROGEN PEROXIDE. |
| IMDG: | HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS WITH MORE THAN 40 BUT NOT MORE THAN 60 PERCENT HYDROGEN PEROXIDE. |
| DOT CLASSIFICATION: | 5.1 (OXIDIZER) |
| DOT LABELS: | OXIDIZER, CORROSIVE |
| DOT MARKING: | HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS WITH MORE THAN 40 BUT NOT MORE THAN 60 PERCENT HYDROGEN PEROXIDE. UN 2014 |
| DOT PLACARD: | 5.1 (OXIDIZER) |
| UN NUMBER: | UN 2014 |
| HAZARDOUS SUBSTANCE/RQ: | NOT APPLICABLE |
| 49 STCC NUMBER: | 4918776 |
| PRECAUTIONS: | PROTECT FROM PHYSICAL DAMAGE. KEEP DRUMS IN TRANSPORT IN UPRIGHT POSITION. DRUMS SHOULD NOT BE STACKED IN TRANSIT. DO NOT STORE DRUMS ON WOODEN PALLETS. |
| OTHER SHIPPING INFORMATION: | ALUMINUM TANKS, DRUM/DOT 420, PACKING GROUP II |

### 15. REGULATORY INFORMATION

| | |
|---|---|
| OSHA EXPOSURE LIMITS | |
| SUBSTANCE(S): | HYDROGEN PEROXIDE |
| OSHA PEL-TWA: | I PPM |
| STEL: | NOT APPLICABLE |
| CEILING: | NOT APPLICABLE |
| SKIN DESIGNATION: | NOT APPLICABLE |
| ACGIH TLV-TWA: | 1 PPM |
| STEL: | NOT APPLICABLE |
| CEILING: | NOT APPLICABLE |
| SKIN DESIGNATION: | NOT APPLICABLE |
| TARGET ORGAN EFFECTS: | SENSORY IRRITATION, EYE, LUNGS, AND SKIN |
| CARCINOGENIC POTENTIAL: | HYDROGEN PEROXIDE |
| REGULATED BY OSHA: | NO |
| LISTED ON NTP REPORT: | NO |
| IARC GROUP 1, 2A, 2B: | NO |

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| | | |
|---|---|---|
| US EPA REQUIREMENTS | | |
| RELEASE REPORTING | | |
| CERCLA (40 CFR 302) | NOT LISTED | |
| LISTED SUBSTANCE(S): | NO | |
| RQ: | NOT APPLICABLE | |
| CATEGORY: | NOT APPLICABLE | |
| RCRA WASTE NO: | NOT APPLICABLE | |
| UNLISTED SUBSTANCE(S): | HYDROGEN PEROXIDE 45.0-59.5% | |
| RQ: | 100 LB. | |
| CATEGORY: | IGNITABILITY, CORROSIVITY | |
| RCRA WASTE NO: | D001, D002 | |
| SARA TITLE III SEC 313 (40 CFR 372): | NOT LISTED | |
| LISTED TOXIC CHEMICAL: | NOT LISTED | |
| REPORTING THRESHOLD: | NOT APPLICABLE | |
| INVENTORY REPORTING | | |
| SARA TITLE III SEC 311/312 (40 CFR 370) | | |
| SUBSTANCE(S): | HYDROGEN PEROXIDE 45.0-59.5% | |
| HAZARD CATEGORY: | FIRE HAZARD, IMMEDIATE (ACUTE) HEALTH HAZARD | |
| PLANNING THRESHOLD..........: | CONC. > 52% | CONC. < 52% |
| | 500 LB. | 10,000 LB. |
| EMERGENCY PLANNING | | |
| SARA TITLE III SEC 302/303 (40 CFR 355) | | |
| LISTED SUBSTANCE(S): | HYDROGEN PEROXIDE > 52% | |
| RQ: | 1 LB. | |
| PLANNING THRESHOLD: | 1000 LB. | |
| US TSCA STATUS: | LISTED | |
| CANADIAN INGREDIENT DISCLOSURE LIST | | |
| SUBSTANCE(S): | HYDROGEN PEROXIDE > 52% | |
| CONTROLLED PRODUCT: | YES | |
| HAZARD SYMBOLS: | CORROSIVE, OXIDIZING, MATERIALS CAUSING OTHER TOXIC EFFECTS | |
| CLASS & DIVISION: | CLASS C, CLASS D, DIV. 2 SUBDIV. B, CLASS E | |
| PRODUCT IDENTIFICATION NO. | 2014 | |
| DOMESTIC SUBSTANCE LIST: | LISTED | |
| CEPA PRIORITY LIST: | NOT LISTED | |
| CARCINOGENICITY: | | |
| ACGIH APPENDIX A: | NOT LISTED | |
| A1 - CONFIRMED HUMAN: | NOT APPLICABLE | |
| A1 - SUSPECTED HUMAN: | NOT APPLICABLE | |
| IARC GROUP 1 OR 2: | NO | |

LABEL LANGUAGE (US/CANADA)

HEALTH: DANGER - CORROSIVE TO EYES AND SKIN. DIRECT EYE CONTACT MAY CAUSE IRREVERSIBLE TISSUE DAMAGE INCLUDING BLINDNESS. INHALATION OF MIST OR VAPOR COULD CAUSE IRRITATION OF LUNGS, NOSE, AND THROAT, USUALLY SUBSIDES AFTER EXPOSURE CEASES. DO NOT INGEST. CORROSIVE TO GASTROINTESTINAL TRACT. MAY BE FATAL IF SWALLOWED.

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PHYSICAL: OXIDIZER INITIATES COMBUSTION IN OTHER MATERIALS BY CAUSING FIRE THROUGH RELEASE OF OXYGEN.

**HANDLING AND STORAGE:**
KEEP CONTAINER IN COOL PLACE (AVOID EXCESSIVE HEAT), AWAY FROM COMBUSTIBLES SUCH AS WOOD, PAPER, OILS, ETC. STORE ONLY IN VENTED CONTAINERS. STORAGE SHOULD CONFORM TO STANDARDS IN NFPA BULLETIN 43A. AVOID CONTAMINATION CONTAMINATION COULD CAUSE DECOMPOSITION AND GENERATION OF OXYGEN WHICH MAY RESULT IN HIGH PRESSURES AND POSSIBLE CONTAINER RUPTURE. DO NOT RETURN UNUSED MATERIAL TO THE ORIGINAL CONTAINER.

WEAR CUP TYPE CHEMICAL SAFETY GOGGLES AND/OR FULL FACE MASK. USE ONLY SUITABLE PROTECTIVE CLOTHING, E.G., RUBBER, NEOPRENE OR SYNTHETIC FIBERS (AVOID COTTON, WOOL, AND LEATHER). USE GLASS, STAINLESS STEEL, ALUMINUM, OR PLASTIC MATERIALS WHEN HANDLING HYDROGEN PEROXIDE. EMPTY DRUMS SHOULD BE TRIPLE RINSED WITH WATER BEFORE DISCARDING.

**FIRST AID:**
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. SEE A PHYSICIAN. WASH CLOTHING BEFORE REUSE.

IF SWALLOWED, DRINK PLENTY OF WATER TO DILUTE. DO NOT INDUCE VOMITING. SEE A PHYSICIAN IMMEDIATELY. CALL THE POISON CONTROL CENTER AT (800) 764-7661 OR (800) 876-4766.

STATE REGULATIONS: CALIFORNIA PROPOSITION 65
SAFE DRINKING WATER AND TOXICS ENFORCEMENT ACT OF 1986 REQUIRES THE GOVERNMENT OF CALIFORNIA TO DEVELOP A LIST OF CARCINOGENS (A) AND REPRODUCTIVE TOXINS (B). NO PERSONS DOING BUSINESS SHALL KNOWINGLY EXPOSE ANY INDIVIDUAL TO A CHEMICAL ON THIS LIST. 70% HYDROGEN PEROXIDE CONTAINS THE INDICATED CONCENTRATION(S) OF LISTED CHEMICALS: CADMIUM (A) LESS THAN 0.1 ppm, CHROMIUM (B) LESS THAN 0.2 ppm, AND LEAD (C) LESS THAN 0.5 ppm. PERCENTAGES LESS THAN 70% HYDROGEN PEROXIDE WOULD CONTAIN PROPORTIONATELY LESS.

### 16. OTHER INFORMATION (PRODUCT USES):

- DUROX (TM) 50% REG & LR MEETS FOOD CHEMICAL CODEX REQUIREMENTS FOR ASEPTIC PACKAGING AND OTHER FOOD RELATED APPLICATIONS.
- OXYPURE® 50% CERTIFIED BY NSF TO MEET ANSI/NSF STD. 60 REQUIREMENTS FOR DRINKING WATER TREATMENT.
- HY BRITE® 50% USED FOR METAL TREATING.
- STANDARD 50% GRADE MOST SUITABLE FOR INDUSTRIAL BLEACHING, PROCESSING, POLLUTION ABATEMENT AND GENERAL OXIDATION REACTIONS.
- SEMICONDUCTOR REG & SEG 50% GRADES, CONFORM TO ACS AND SEMI SPECS. FOR WAFER ETCHING AND CLEANING AND APPLICATIONS REQUIRING LOW RESIDUES.
- SUPER D® 50% COMPLIES WITH PHARMACOPOEIA SPECIFICATIONS SUITABLE FOR PREPARING DILUTE SOLUTIONS FOR PHARMACEUTICAL AND/OR COSMETIC APPLICATIONS.
- TECHNICAL 50% ESSENTIALLY FREE OF INORGANIC METALS, SUITABLE FOR CHEMICAL SYNTHESIS.
- CHLORATE GRADE 50% SPECIALLY FORMULATED FOR USE IN CHLORATE MANUFACTURE OR PROCESSING.

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## HYDROGEN PEROXIDE (45% - 59.5%)

THE CONTENTS AND FORMAT OF THIS MSDS ARE IN ACCORDANCE WITH OSHA HAZARD COMMUNICATION STANDARD AND CANADA'S WORKPLACE HAZARDOUS INFORMATION SYSTEM (WHMIS). ALL INFORMATION APPEARING HEREIN IS BASED UPON DATA OBTAINED FROM THE MANUFACTURER AND/OR RECOGNIZED TECHNICAL SOURCES. WHILE THE INFORMATION IS BELIEVED TO BE ACCURATE, ASP MAKES NO REPRESENTATIONS AS TO ITS ACCURACY OR SUFFICIENCY. CONDITIONS OF USE ARE BEYOND ADVANCED STERILIZATION PRODUCT'S CONTROL AND THEREFORE USERS ARE RESPONSIBLE TO VERIFY THIS DATA UNDER THEIR OWN OPERATING CONDITIONS TO DETERMINE WHETHER THE PRODUCT IS SUITABLE FOR THEIR PARTICULAR PURPOSES AND THEY ASSUME ALL RISKS OF THEIR USE, HANDLING, AND DISPOSAL OF THE PRODUCT OR FROM THE PUBLICATION OF USE OF, OR RELIANCE UPON, INFORMATION CONTAINED HEREIN. THIS INFORMATION RELATES ONLY TO THE PRODUCT DESIGNATED HEREIN, AND DOES NOT RELATE TO ITS USE IN COMBINATION WITH ANY OTHER MATERIAL OR IN ANY OTHER PROCESS.

Reference: HYDROGEN PEROXIDE 40-60% MATERIAL SAFETY DATA SHEET FROM VAN WATERS & ROGERS INC., VERSION 003, MSDS# FZ000041

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# CIDEX® OPA SOLUTION

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FOR PRODUCT ASSISTANCE CONTACT ADVANCED STERILIZATION PRODUCTS - (800) 755-5900
EMERGENCY TELEPHONE NUMBERS: CHEMTREC (800) 262-8200
Prepared to U.S. OSHA, CMA, ANSI, and Canadian WHMIS

**Advanced Sterilization Products**
**a Johnson & Johnson Company**
**33 Technology Drive**
**Irvine, CA 92618-2346**

## PART I *What is the material and what do I need to know in an emergency?*

### 1. PRODUCT IDENTIFICATION

| | |
|---|---|
| TRADE NAME (AS LABELED): | **CIDEX® OPA SOLUTION** |
| CHEMICAL NAME/CLASS: | Ortho-phthalaldehyde and Inorganic Salt Solution,<br>CAS # 643-79-8 |
| PRODUCT USE: | High Level Disinfectant |
| SUPPLIER/MANUFACTURER'S NAME: | **ADVANCED STERILIZATION PRODUCTS** |
| U.S. ADDRESS: | 33 Technology Drive<br>Irvine, CA 92618 |
| U.S. EMERGENCY PHONE: | CHEMTREC: 1-800-424-9300<br>CHEMTREC INTERNATIONAL: 1-703-527-3887 |
| U.S. BUSINESS PHONE: | 1-800-595-0200 |
| DATE OF PREPARATION: | Release date. |

### 2. COMPOSITION and INFORMATION ON INGREDIENTS

Ingredients that are 1% or greater need to be reported on an MSDS unless the component is carcinogenic. Since CIDEX OPA Solution has the active ingredient at 0.55% (99.45% inactive ingredients), and none of the components are carcinogenic, this section is not applicable.

### 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** This is a clear, light blue solution that is practically odorless. **Health Hazards:** This product is predominantly water and presents minimal hazards. The health hazards associated with contact with this product include the potential for irritation of the eyes, skin, nose, and other tissues. **Flammability Hazards:** Non flammable. **Reactivity Hazards:** Negligible.

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LIKELY ROUTE OF EXPOSURE: Inhalation, skin/eye contact.

INHALATION: Breathing vapors may be irritating to the nose, throat, or respiratory system. May cause coughing, chest discomfort and tightness, difficulty when breathing, or headache. Symptoms subside when exposure ends. Preexisting bronchitis or asthma conditions can be aggravated by exposure to this product. Heating of the solution will increase its potential for irritation.

CONTACT WITH SKIN or EYES: Persons with potential exposure should not wear contact lenses. Direct eye contact with the product may cause stinging, excess tearing, and redness. Skin contact may cause staining, especially after prolonged exposure. Repeated skin contact may cause dermatitis.

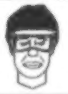
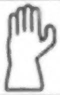
INGESTION: Ingestion may cause irritation or chemical burns of the mouth, throat, esophagus, and stomach. Symptoms may include vomiting, diarrhea, and nausea.

INJECTION: Injection of this material would lead to pain, mild irritation, and swelling at the site of injection.

1.

**HAZARDOUS MATERIAL INFORMATION SYSTEM**

| | | |
|---|---|---|
| **HEALTH** | (BLUE) | 1 |
| **FLAMMABILITY** | (RED) | 0 |
| **REACTIVITY** | (YELLOW) | 0 |
| **PROTECTIVE EQUIPMENT** | | B |

| EYES | RESPIRATORY | HANDS | BODY |
|---|---|---|---|
|  | SEE SECTION 8 |  | SEE SECTION 8 |

For routine applications.

## PART II *What should I do if a hazardous situation occurs?*

### 4. FIRST-AID MEASURES

SKIN EXPOSURE: Wash affected area immediately with plenty of soap and water for at least 15 minutes. If a skin reaction should occur, seek medical advice.

EYE EXPOSURE: Go to the nearest eyewash station and rinse immediately with plenty of water for at least 15 minutes. Seek medical advice.

INHALATION: If inhaled, remove person exposed to fresh air, and seek medical advice.

INGESTION: If swallowed, do not induce vomiting. Seek medical advice immediately. CALL PHYSICIAN OR YOUR LOCAL POISON CONTROL CENTER FOR MOST CURRENT INFORMATION.

### 5. FIRE-FIGHTING MEASURES

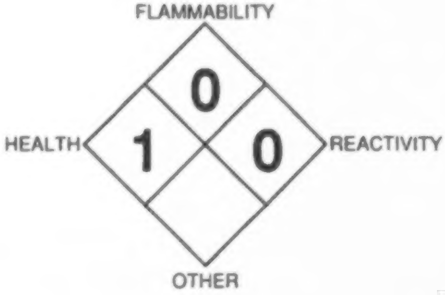
FLASH POINT: Not applicable.

FLAMMABLE LIMITS (in air by volume, %): Not applicable.

FIRE EXTINGUISHING MATERIALS: Select fire extinguishing media appropriate for the surrounding area.

SPECIAL FIRE-FIGHTING PROCEDURES: Wear self contained breathing apparatus, eye protection and protective clothing to prevent contact with skin and eyes.

**NFPA RATING**



### 6. ACCIDENTAL RELEASE MEASURES

RELEASE RESPONSE: Responders should wear appropriate personal protective equipment (for example, chemical goggles, gloves, apron, or lab coat) during the clean up of spills. See Section 13 for disposal.

For spill neutralization, sprinkle approximately 25 grams of glycine (free base) powder per gallon of estimated CIDEX® OPA Solution spill. With a mop or other tool, thoroughly blend the glycine into the spill. Allow 5 minutes for deactivation of *o*-phthalaldehyde. Close storm-water drains and take other measures to protect human health and the environment, as necessary. Place all neutralized spill residue and disposable clean-up materials in an appropriate container and seal. Rinse area and tools with soap and water solution and follow with a water rinse. Dispose of in accordance with applicable U.S. Federal, state, or local regulations, or appropriate standards of Canada (see Section 13, Disposal Considerations).

## PART III *How can I prevent hazardous situations from occurring?*

### 7. HANDLING and STORAGE

WORK AND HYGIENE PRACTICES: All employees working with this product must be properly trained. Avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Avoid breathing mists and sprays of this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Store containers in a cool, dry location (15-30°C, 59-86°F), away from direct sunlight, or sources of intense heat. Store away from incompatible materials (see Section 10, Stability and Reactivity). Keep container tightly closed when not in use. Empty containers may contain residual amounts of this product; and must be triple rinsed prior to disposal.

### 8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use adequate ventilation. If existing ventilation is not adequate, product should be used with a local exhaust hood, or in ductless fume hoods/portable ventilation system.

RESPIRATORY PROTECTION: None normally required for routine use.

EYE PROTECTION: Safety glasses/goggles as authorized in 29 CFR 1910.133, applicable U.S. State regulations, or the appropriate standards of Canada.

HAND PROTECTION: Latex, PVC, or nitrile rubber gloves for routine use. Latex gloves should be changed frequently (every 10-15 minutes) during use of product. Use double gloves for spill response (latex covered by nitrile rubber) and follow Accidental Release Measures provided in Section 6 of this MSDS.

BODY PROTECTION: Use safety glasses/chemical goggles, gloves, apron, or lab coat.

### 9. PHYSICAL and CHEMICAL PROPERTIES

EVAPORATION RATE (n-BuAc = 1): Similar to water.
SPECIFIC GRAVITY (water = 1): 1.0003 g/cc
SOLUBILITY IN WATER: Soluble.
pH (0.1 M Solution): 7.2-7.8.
FLASH POINT: Not applicable.
COLOR: Clear, light blue.
MELTING/FREEZING POINT: 0°C (32°F)
BOILING POINT: 100°C (212°F)
ODOR: Practically odorless.
FORM: Liquid.

HOW TO DETECT THIS SUBSTANCE (warning properties): The color may be a distinguishing characteristic for this product, if spilled. The product stains proteins on surfaces to grey/black.

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### 10. STABILITY and REACTIVITY

STABILITY: Stable.

INCOMPATIBILITY: Strong acids, strong bases, and strong oxidizers.

## PART IV *Is there any other useful information about this material?*

### 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA:
Eye exposure (rabbit) = slightly irritating, but reversible in seven days
$LD_{50}$ (oral, rat) > 5000 mg/kg
$LD_{50}$ (skin, rabbit) > 2000 mg/kg

SUSPECTED CANCER AGENT: This product's components are not found on the following lists: U.S. FEDERAL OSHA Z LIST, NTP, IARC, and CAL/OSHA.

SENSITIZATION TO THE PRODUCT: Non sensitizer

REPRODUCTIVE TOXICITY INFORMATION

Mutagenicity: Rat (acute in vivo cytogenetics assay with OPA >99%) — Negative
(Gene mutation in mammalian cells in vitro with OPA >99%) — Negative
Ames Assay (gene mutation in bacteria with OPA >99%) — Negative
(Sister chromatid exchange assay in vitro with Chinese hamster ovary cells OPA >99%) — weakly positive.
Teratology: Rat NOEL: 20 mg/kg/day

No controlled clinical study data is available.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Preexisting asthma, bronchitis, or dermatitis and other skin disorders can be aggravated by exposure to this product.

RECOMMENDATIONS TO PHYSICIANS: Probable mucosal damage from oral exposure may contraindicate the use of gastric lavage.

### 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The components of this product will slowly decompose into inorganic and organic compounds.

### 13. DISPOSAL CONSIDERATIONS

Waste disposal must be in accordance with appropriate U.S. Federal, state, and local regulations or with regulations of Canada. Spent CIDEX® OPA Solution may be disposed down the drain, where authorized.

### 14. TRANSPORTATION INFORMATION

THIS MATERIAL IS NOT HAZARDOUS, PER THE U.S. DEPARTMENT OF TRANSPORTATION (49 CFR 172.101).

MARINE POLLUTANT: No component of this product is designated as a Marine Pollutant, per Appendix B to 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS NOT CONSIDERED AS DANGEROUS GOODS.

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### 15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: The components of this product are not subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. TSCA INVENTORY STATUS: The components of this product are listed on the TSCA Inventory.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this product is on the California Proposition 65 lists.

**ADDITIONAL CANADIAN REGULATIONS:**

CANADIAN DSL/NDSL INVENTORY STATUS: The components of this product are listed on the DSL inventory.

CANADIAN WHMIS SYMBOLS: ***Class D2B:*** *Other Toxic Effects*

### 16. OTHER INFORMATION

**PREPARED BY:**
Advanced Sterilization Products
33 Technology Drive
Irvine, CA 92618

**DATE OF PRINTING:** October 25, 1999

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Advanced Sterilization Products assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, Advanced Sterilization Products assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in her use of the material.

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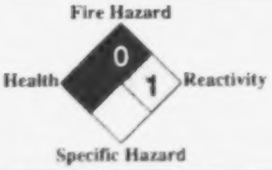
# INSTITUTIONAL FORMULA DRANO

**National Fire Protection Association (NFPA)**



**Hazardous Material Information System (HMIS)**

| | |
|---|---|
| | 3 |
| Fire Hazard | 0 |
| Reactivity | 1 |

**Protective Clothing** Hand, feet, and eye protection required

**Emergency Overview** Clear Straw color. Liquid. See Section 9. DANGER. CORROSIVE. CAUSES EYE AND SKIN BURNS. HARMFUL OR FATAL IF SWALLOWED.

## Section 1. Chemical Product and Company Identification

| | |
|---|---|
| **Product Name** | INSTITUTIONAL FORMULA DRANO |
| **Product Use** | Industrial/Institutional: Cleaning product. |
| **MSDS#** | 126061002 |

**U.S. Headquarters**
Drackett Professional
A Division of
S.C. Johnson Commercial Markets, Inc.
8310 16th Street
Sturtevant, Wisconsin 53177-0902
Phone: (888) 352-2249

| | |
|---|---|
| **Code** | 90485 |
| **PMS#** | 433205 |
| **Validation Date** | 04/19/2000 |
| **Print Date** | 04/20/2000 |
| **Supersedes** | 04/13/2000 |
| **In Case of Emergency** | (800) 851-7145 |

## Section 2. Composition and Information on Ingredients

| Ingredients | CAS # | % by Weight | Exposure Limits | LC50/LD50 |
|---|---|---|---|---|
| Sodium Hydroxide | 1310-73-2 | 30-60 | CEIL: 2 ($mg/m^3$) from OSHA (PEL) [United States]<br>STEL: 2 ($mg/m^3$) from ACGIH (TLV) [United States] | Not available. |
| Water | 7732-18-5 | 60-100 | Not available. | Not applicable. |

## Section 3. Hazards Identification

| | | |
|---|---|---|
| **Routes of Entry** | | Inhalation. Skin contact. Eye contact. |
| **Potential Acute Health Effects** | *Eyes* | Corrosive. May cause permanent damage including blindness. |
| | *Skin* | Corrosive. May cause permanent damage. |
| | *Inhalation* | May cause irritation and corrosive effects to nose, throat, and respiratory tract. |
| | *Ingestion* | Corrosive. May cause burns to mouth, throat, and stomach. |
| **Medical Conditions Aggravated by Overexposure:** | | None known. |

See Toxicological Information (section 11)

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Continued on Next Page

Material Safety Data Sheet

## INSTITUTIONAL FORMULA DRANO

### Section 4. First Aid Measures

| | |
|---|---|
| **Eye Contact** | Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Get medical attention immediately. |
| **Skin Contact** | Flush immediately with plenty of water for at least 15 minutes. Get medical attention immediately. |
| **Inhalation** | If breathing is difficult: Remove to fresh air. Get medical attention immediately. |
| **Ingestion** | Do not induce vomiting! Immediately drink plenty of water. Never give anything by mouth to an unconscious person. Get medical attention immediately. |

### Section 5. Fire Fighting Measures

| | |
|---|---|
| **Flammability of the Product** | None known. |
| **Flash Points** | Not available. |
| **Products of Combustion** | None known. |
| **Fire Fighting Media and Instructions** | Extinguish with water spray or carbon dioxide, dry chemical powder or appropriate foam. Normal fire fighting procedure may be used. |
| **Protective Clothing (Fire)** | Put on appropriate personal protective equipment (see Section 8). |
| **Special Remarks on Fire and Explosion Hazards** | Corrosive material (see Sections 8 and 10). |

### Section 6. Accidental Release Measures

| | |
|---|---|
| **Personal Precautions** | Put on appropriate personal protective equipment (see Section 8). |
| **Environmental Precautions and Clean-up Methods** | In the event of major spillage: Use appropriate containment to avoid environmental contamination. Sweep or scrape up material. Place in suitable clean, dry containers for disposal by approved methods. Use a water rinse for final clean-up. |

### Section 7. Handling and Storage

| | |
|---|---|
| **Handling** | Avoid contact with eyes, skin, and clothing. Do not taste or swallow. Avoid breathing vapors or spray mists. Wash thoroughly after handling. Remove and wash contaminated clothing and footwear before re-use. Product residues may remain on/in empty containers. All precautions for handling the product must be used in handling the empty container and residue. FOR INDUSTRIAL USE ONLY. |
| **Storage** | Store in a dry, cool, and well-ventilated area. Protect from freezing. Keep container tightly closed. KEEP OUT OF REACH OF CHLDREN. |

### Section 8. Exposure Controls/Personal Protection

| | |
|---|---|
| **Engineering Controls** | Good general ventilation should be sufficient to control airborne levels. Respiratory protection is not required if good ventilation is maintained. |
| **Personal Protection** | |
| *Eyes* | Chemical splash goggles. |
| *Hands* | Chemical resistant gloves. Includes: Rubber gloves. Neoprene gloves. |
| *Respiratory* | If mists/vapors are not adequately controlled by ventilation, use appropriate respiratory protection to avoid over exposure. A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. |
| *Feet* | No special protective clothing is required. |
| *Body* | If major exposure is possible, wear suitable protective clothing and footwear. |

*Continued on Next Page*

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Material Safety Data Sheet

# INSTITUTIONAL FORMULA DRANO

## *Section 9. Physical and Chemical Properties*

| | |
|---|---|
| **Physical State and Appearance** | Liquid. |
| **Odor** | Ammoniacal. |
| **Color** | Clear. Straw color. |
| **pH** | >13 [Basic.] |
| **Specific Gravity** | 1.35 |
| **Boiling/Condensation Point** | 120°C (248°F) |
| **Melting/Freezing Point** | 0°C (32°F) |
| **Solubility in Water** | Complete. |

## *Section 10. Stability and Reactivity*

| | |
|---|---|
| **Stability and Reactivity** | The product is stable. |
| **Conditions of Instability** | None known. |
| **Incompatibility with Various Substances** | Reactive with oxidizing agents, acids. Do not mix with any other chemicals or products unless specified by label. |
| **Hazardous Decomposition Products** | When exposed to fire: Produces normal products of combustion. |
| **Hazardous Polymerization** | Will not occur. |

## *Section 11. Toxicological Information*

| | |
|---|---|
| **Acute Toxicity** | ORAL (LD50). Estimated to be less than 500 mg/kg (rat). |
| **Effects of Chronic Exposure** | None known. |
| **Other Toxic Effects** | Not available. |

## *Section 12. Ecological Information*

**Not available.**

## *Section 13. Disposal Considerations*

| | |
|---|---|
| **Waste Information** | Undiluted product is regulated under environmental and transportation laws as a corrosive waste. Dispose of according to all federal, state, and local regulations. |

## *Section 14. Transport Information*

**DOT Classification**

| | |
|---|---|
| **DOT Proper Shipping Name** | Corrosive liquids, n.o.s. (Sodium hydroxide) |
| **DOT Class** | Class 8: Corrosive material |
| **UN/NA** | UN1760 |
| **Packing Group** | II |
| **DOT Special Considerations** | Limited Quantity |

**TDG Classification**

| | |
|---|---|
| **TDG Class** | Not applicable |
| **PIN/NIP** | |
| **TDG Special Considerations** | |

*Continued on Next Page*

# INSTITUTIONAL FORMULA DRANO

## Section 15. Regulatory Information

**Reporting in this section is based on ingredients disclosed in Section 2**

**US Regulations**

| | |
|---|---|
| **Federal** | Clean Water Act (CWA) 311: Sodium Hydroxide<br>CERCLA: Hazardous substances.: Sodium Hydroxide |
| **State** | New Jersey spill list: Sodium Hydroxide<br>New Jersey: Sodium Hydroxide<br>Massachusetts spill list: Sodium Hydroxide<br>Massachusetts RTK: Sodium Hydroxide<br>Pennsylvania RTK: Sodium Hydroxide<br>This product is not subject to the reporting requirements under California's Proposition 65. |
| **Registered Product Information** | Not applicable. |

**Canadian Regulations**

| | |
|---|---|
| **WHMIS Classifications** | Not applicable. |
| **WHMIS Icon** | |
| **Registered Product Information** | Not applicable. |
| **Chemical Inventory Status** | All ingredients of this product are listed or are excluded from listing on the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory. |

## Section 16. Other Information

| | |
|---|---|
| **Other Special Considerations** | Not available. |
| **Version** | 1 |

**Notice to Reader**

*This document has been prepared using data from sources considered technically reliable. It does not constitute a warranty, express or implied, as to the accuracy of the information contained within. Actual conditions of use and handling are beyond seller's control. User is responsible to evaluate all available in formation when using product for any particular use and to comply with all Federal, State, Provincial, and Local laws and regulations.*

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**OBJECTIVE 28**

## Assignment Sheet 4—Analyze Severe Weather Scenarios

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Scenario 1 responses appropriate per information in Objective 12 | ______ |
| • Scenario 2 responses appropriate per information in Objective 12 | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

__________________________________________________________________

__________________________________________________________________

**INTRODUCTION**

You should know how to take shelter should severe weather threaten your place of employment or school building. To take shelter quickly and effectively, you must know your role in your organization's severe weather plan and the location of the building's shelter area.

Most schools and medical facilities hold routine severe weather drills. You must take these drills with the utmost seriousness. Were severe weather to occur, your knowledge of your responsibilities and the organization's shelter locations could save your life and that of others.

The following scenarios were designed to habituate you to the general sequence of actions to take in a severe weather emergency and should not take the place of actual drills at your place of employment or school.

**EXERCISE**

**DIRECTIONS**

Read the scenarios on the following page. Write, in order, the exact steps you would take in response to the weather emergency described. Use additional space as needed.

**SCENARIO 1**

You and several of your co-workers are standing before the window on the fifth floor of the hospital, checking out the "weird" weather. It is hailing, and though it is only mid-afternoon, it has become very dark. The air has a greenish tinge to it. Just as you are about to return to work, the radio at the nurse's station announces that a tornado watch is in effect for your county. What do you do?

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________

**SCENARIO 2**

Earlier, you heard on the radio that your county is under a tornado watch. You and several of your co-workers are standing before the window on the fifth floor of the hospital, checking out the "weird" weather. It is hailing, and though it is only mid-afternoon, it has become very dark. The air has a greenish tinge to it. Just as you are about to return to work, the local civil defense severe weather alarm sounds, and the radio at the nurse's station announces that a tornado warning is in effect. What do you do?

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________

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**OBJECTIVE 29**

## Assignment Sheet 5—Analyze Fire Emergency Scenarios

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Scenario 1 responses appropriate per information in Objectives 14 and 15 | ______ |
| • Scenario 2 responses appropriate per information in Objectives 14 and 15 | ______ |
| **Overall rating** | ______ |

Evaluator's comments ____________________________________________

__________________________________________________________

__________________________________________________________

**INTRODUCTION**

You should know how to immediately evacuate your place of employment or school building in case of fire. To evacuate a building quickly and effectively, you must know your organization's fire evacuation plan, your designated role(s) in that plan, and all building evacuation routes.

Schools and medical facilities hold routine fire evacuation drills. These drills must be taken with the utmost seriousness. Were a real fire to occur, your knowledge of your responsibilities and proper evacuation routes could save your life and that of others.

The following scenarios were designed to habituate you to the sequence of actions to take in a fire emergency. They, of course, should not take the place of actual fire drills at your place of employment or school.

**EXERCISE**

**DIRECTIONS**

Read the scenarios on the following page. Write, in order, the exact steps you would take in response to the fire emergency described. Use additional space as needed.

**SCENARIO 1**

It is 4 PM, on a cold, rainy December afternoon. You and Almed, a new employee, are in the basement of a hospital in the lab. This is the first day of work for Almed. English is his second language and he has yet to master it with facility. He has not participated in a fire drill and does not know the hospital's evacuation routes and procedures.

When you open the door to an adjoining storage room, you discover, a fast-moving fire climbing chemical storage shelves. What do you do?

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________

**SCENARIO 2**

You are on the fifth floor of the hospital waiting for the elevator. With you is Jean Watson, a nonambulatory surgery patient who you are taking to x-ray on the first floor. Two visitors, a young boy and his mother, are also waiting for the elevator. Just as the four of you enter the elevator, the fire alarm goes off. What do you do?

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________

10. ______________________________

11. ______________________________

12. ______________________________

OBJECTIVE 30

## Assignment Sheet 6—Apply Safety Principles to the School and Workplace

Name ______________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| - Answers are appropriate per information in the Information Sheet and the student's workplace safety procedures | ______ |
| - Answers are relevant and specific | ______ |
| - Answers are legible and grammatical | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________

EXERCISE

DIRECTIONS

Describe what you should do in each of the following situations concerning safety in your school and at your medical facility. Be as specific as possible. Refer to the Information Sheet, to your school handbook, and to the policies and procedures manual for your medical facility as necessary.

### PERSONAL PROTECTIVE EQUIPMENT AND ATTIRE

1. Required personal protective equipment (PPE) and attire

   School ______________________

Medical Facility ____________________

____________________

____________________

____________________

2. Situations under which PPE requirements will vary

School ____________________

____________________

____________________

____________________

Medical Facility ____________________

____________________

____________________

____________________

SAFETY PROCEDURES

1. You have an accident or see one happen

School ____________________

____________________

____________________

____________________

Medical Facility ____________________

____________________

____________________

____________________

2. The plug on a piece of electrical equipment you need to use is dangling from the cord, and the electrical wire is exposed

School ____________________________________________

____________________________________________

____________________________________________

____________________________________________

Medical Facility ____________________________________________

____________________________________________

____________________________________________

____________________________________________

3. You spill some commercial cleaning agent on your skin and need to find out if the agent can have harmful effects on skin contact

School ____________________________________________

____________________________________________

____________________________________________

____________________________________________

Medical Facility ____________________________________________

____________________________________________

____________________________________________

____________________________________________

4. You answer the telephone and it is a bomb threat

School ____________________________________________

____________________________________________

____________________________________________

____________________________________________

Medical Facility ____________________________________________

____________________________________________

____________________________________________

____________________________________________

## SEVERE WEATHER

1. You hear a severe weather alert (civil defense sirens)

School ______________________________

______________________________

______________________________

______________________________

High-rise Medical Facility ______________________________

______________________________

______________________________

______________________________

2. The radio announces a severe weather watch

School ______________________________

______________________________

______________________________

______________________________

Medical Facility ______________________________

______________________________

______________________________

______________________________

## FIRE SAFETY

1. You discover a fire in the rest room wastebasket

School ______________________________

______________________________

______________________________

______________________________

Medical Facility ______________________________

______________________________

______________________________

______________________________

2. When you open the door to the cleaning supplies closet, the smoke detector goes off and thick smoke billows out. You are facing a fire that has already advanced several storage shelves above your head

School ______________________________

______________________________

______________________________

______________________________

High-Rise Medical Facility ______________________________

______________________________

______________________________

______________________________

OBJECTIVE 31

## Job Sheet 1—Use Proper Body Mechanics in Standing, Sitting, Moving, and Lifting

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Demonstrated correct standing posture | ______ |
| • Demonstrated correct sitting posture | ______ |
| • Demonstrated correct moving posture | ______ |
| • Demonstrated correct procedure for lifting a heavy object safely, with and without assistance from another person | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________

______________________________________________________

______________________________________________________

---

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Two students, one to perform the task and one to assist when necessary
- Office with desk, adjustable desk chair, computer, mouse pad, mouse
- Operating room with operating table and scrub sink
- Lumbar roll or towel
- High shelving with object on top shelf
- Stepladder or straight ladder
- Cart and/or wheelchair as appropriate to object being moved
- Heavy object(s) to be lifted and moved
- Watch with second hand

**PROCEDURE**

☐ 1. Demonstrate correct standing posture while completing the following actions:

  ☐ a. Stand beside operating table for 30 seconds.

    - Align ears, shoulders, hips, knees, and ankles.
    - Relax shoulders, and slightly bend knees.
    - Position feet slightly apart.

- ☐ b. Stand beside operating table for three minutes.
    - Align ears, shoulders, hips, knees, and ankles.
    - Relax shoulders, and slightly bend knees.
    - Position feet slightly apart with one foot elevated on a footstool or rail.
- ☐ c. Walk to scrub sink.
    - Align ears, shoulders, hips, knees, and ankles.
    - Hold head erect.
- ☐ d. Wash hands at scrub sink.
    - Align ears, shoulders, hips, knees, and ankles.
    - Relax shoulders, and slightly bend knees.
    - Place feet slightly apart.
    - Stand as close to work area as necessary to prevent reaching.

☐ 2. Demonstrate correct sitting posture while completing the following actions:

- ☐ a. Sit at a desk before a computer.
    - Adjust seat back firmness and angle as necessary.
    - Place a towel or lumbar roll between lower back and back of chair.
    - Align ears over shoulders, and align shoulders over hips.
    - Rest buttocks against chair back.
    - Rest feet on floor or footstool.
- ☐ b. Use a computer.
    - Adjust height of work area as necessary.
    - Place computer screen at eye level and at comfortable distance from eyes.
    - Cushion and support wrist and arm when using computer keyboard.

☐ 3. Demonstrate correct lifting techniques and moving posture while performing the following actions:

- ☐ a. Retrieve an object from a high shelf.
    - Place a ladder securely and have assistant brace it.
    - Position the ladder so that you do not need to overreach, stretch, or lean from the ladder to retrieve the object.

- ☐ b. Move a large, heavy object 10 feet.
  - Ask for help in carrying object.
  - Use a cart, wheelchair, bed sheets, or other device.
  - Pivot, roll, or slide the object if a carrying device is unavailable.

☐ 4. Demonstrate correct lifting procedure (single-person lift and carry).

- ☐ a. Approach the object and size up its weight.
- ☐ b. Consider your physical ability and determine whether or not you need help in lifting the object.
- ☐ c. Place your feet close to the object and 8 to 12 inches apart for good balance.
- ☐ d. Bend your knees and get a good handhold.
- ☐ e. Using your leg muscles and keeping your back straight, lift the object straight up, keeping it close to your body.
- ☐ f. Lift the object into carrying position, making no turning or twisting movements until the lift is completed.
- ☐ g. Turn your body with changes of foot position after looking over your path of travel, making sure it is clear.
- ☐ h. Carry the object 10 feet.
- ☐ i. Set the object down, bending your knees, keeping your back straight, and using your leg muscles.

☐ 5. Demonstrate the correct two-person lift and carry procedure:

- ☐ a. Position yourselves on either side of the object.
  - Place your feet close to the object.
  - Keep your feet 8 to 12 inches apart for good balance.
- ☐ b. Bend your knees and get a good handhold.
- ☐ c. Lift object straight up.
  - Use your leg muscles.
  - Coordinate your movements.
  - Keep your back straight.
  - Keep object close to your body.

☐ d. Lift the object between you into carrying position.
  - Make no turning or twisting movements until the lift is completed.
  - Carry object on same side of body.

☐ e. Turn in desired direction of travel.
  - First looking over your path of travel, making sure it is clear.
  - Announce the direction you intend to turn.
  - Coordinate your movements.
  - Do not twist; move your feet instead.

☐ f. Carry the object 10 feet.
  - Coordinate your movements.

☐ g. Set the object down.
  - Announce your intentions.
  - Coordinate your actions.
  - Bend your knees.
  - Keep your back straight.
  - Use your leg muscles.

Evaluator's Comments: ____________________

____________________

____________________

**OBJECTIVE 32**

## Job Sheet 2—Operate a Portable Fire Extinguisher

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Sized up the fire | ______ |
| • Planned escape route | ______ |
| • Identified appropriate extinguisher for fire class | ______ |
| • Pulled pin and tested extinguisher briefly | ______ |
| • Carried extinguisher to within stream reach of fire | ______ |
| • Aimed agent at base of fire and applied agent in slow sweeps | ______ |
| • Applied agent until fire was out | ______ |
| • Backed away from fire area | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

______________________________________________

______________________________________________

---

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Fire department representative to light fire and conduct exercise safely
- Selection of portable fire extinguishers
- Protected outdoor area, free of wind and combustibles (a parking lot or paved area to the lee side of a building works well)
- Small Class A fire in an office-sized trash basket
- Appropriate out-of-order tags

**PROCEDURE**

☐ 1. Size up the fire to make sure that it is appropriate to fight with an extinguisher.

☐ 2. Determine your escape route.

☐ 3. Identify and select an extinguisher appropriate for the type of fire.

☐ 4. Pull pin at top of extinguisher to break the inspection band.

☐ 5. Test the extinguisher briefly to ensure proper operation.

  ☐ a. Point nozzle in safe direction.

  ☐ b. Discharge very short test burst.

☐ 6. Carry the extinguisher by its handle to within stream reach of the fire, keeping yourself upwind of the fire with your back to your planned escape route.

☐ 7. Release the discharge horn or nozzle and aim it at the base of the fire.

☐ 8. Squeeze the handle to discharge the extinguishing agent in a slow back and forth sweep at base of flames.

⚠ **CAUTION:** The frost residue from the carbon dioxide gas that forms on the nozzle horn of carbon dioxide extinguishers can cause frostbite when contacted.

☐ 9. Continue to apply the agent for several seconds after the flames are extinguished to make sure that fire is out.

☐ 10. Back away from fire area.

☐ 11. Tag extinguisher for refill and inspection, and remove from service.

Evaluator's Comments: ____________________________________________

____________________________________________

____________________________________________

# Introduction to Surgical Technology

## SECTION B:
## Safety

### Module 2-B: Workplace Safety

## Module Contents

**COMPONENTS**

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# Introduction to Surgical Technology
## Section B: Safety
## Module 2-B: Workplace Safety

**PREREQUISITES:** **Module 1-B**

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 3.

☐ 5. **Research** Online resources to learn more about the workplace safety. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Study** Information Sheet, Objective 4 through Objective 9.

**Optional**

☐ 7. **Do** Teacher Supplement 1, "OSHA Workplace Violence Checklist" to identify present or potential violence problems in your school or workplace.

✔ **NOTE:** This checklist may be obtained from your instructor.

☐ 8. **Study** Information Sheet, Objective 10 and Objective 11.

**Optional**

☐ 9. **View** Videotape entitled *Hazard Communications Right to Know—Nursing.*

☐ 10. **Study** Information Sheet, Objective 12.

☐ 11. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 12. **Do** Job Sheet 1, "Maneuver a Wheelchair Safely."

☐ 13. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 14. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat steps 8, 10, 11, and 12.

☐ 14. **Observe** Demonstration of procedures to be used in completing Job Sheet 2.

☐ 15. **Do** Job Sheet 2, "Maneuver a Stretcher Safely."

☐ 16. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 17. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat steps 8, 14, and 15.

☐ 17. **Study** Information Sheet, Objective 13 through Objective 19.

Optional

☐ 18. **View** Videotape entitled *Updated Bloodborne Pathogens.*

☐ 19. **Study** Information Sheet, Objective 20 through Objective 24.

Optional

☐ 20. **View** Videotape(s) entitled *Needlestick Prevention* and/or *BBP & Needlestick Prevention for Healthcare Workers.*

☐ 21. **Study** Information Sheet, Objective 25 through Objective 27.

Optional

☐ 22. **View** Videotape entitled *Universal Precautions—Infection Control Procedures.*

☐ 23. **Study** Information Sheet, Objective 28 through Objective 30.

☐ 24. **Observe** Demonstration of procedures to be used in completing Job Sheet 3.

☐ 25. **Do** Job Sheet 3, "Demonstrate Effective Hand Washing Procedure."

☐ 26. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 27. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat steps 21, 23, and 25.

☐ 27. **Study** Information Sheet, Objective 31 through Objective 47.

☐ 28. **Take** Written Test provided by your instructor.

☐ 29. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 30. If the evaluation is not satisfactory, repeat steps 4, 6, 8, 10, 17, 21, 23, and 27.

☐ 30. **Check** With your instructor for any additional assignments to be completed.

☐ 31. **Do** Additional assignments your instructor lists below.

☐ 32. **Take** Module Review provided by your instructor.

☐ 33. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 34. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, job sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

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# Introduction to Surgical Technology
## Section B: Safety
## Module 2-B: Workplace Safety

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to follow basic health care workplace safety guidelines, including Standard Precautions and those safety guidelines for workplace violence, hazard communications, protection from bloodborne pathogens, radiation, electrosurgery, and laser use. You should demonstrate these competencies by completing the job sheets and by scoring 100 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Describe OSHA regulations required of employers.
2. Complete statements concerning OSHA and its role in workplace health and safety.
3. Complete statements concerning OSHA risk factors for violence to health care workers.
4. Name the four main components to any effective safety and health program that also apply to preventing workplace violence.
5. List responsibilities of management in creating an effective workplace violence prevention program.
6. List responsibilities of employees in creating an effective workplace violence prevention program.
7. Complete statements concerning OSHA-recommended engineering controls and workplace adaptation that can effectively prevent or control workplace violence hazards.
8. Complete statements concerning OSHA-recommended administrative and work practice controls to help prevent workplace violence.
9. List records that are important to the success of a workplace violence prevention program.
10. Select true statements concerning hazard communications.
11. Select true statements concerning information on a chemical label.
12. Complete basic health care workplace safety guidelines.
13. Match personal protective equipment (PPE) to their protective requirements.
14. Match major types of reactions to latex to their characteristics.
15. List ways of preventing latex allergy.
16. Complete statements concerning bloodborne pathogens.

17. Select true statements concerning the five different types of hepatitis.
18. Select true statements concerning bloodborne pathogens and their concern to operating room professionals.
19. Complete a chart comparing HIV and HBV.
20. List examples of devices that can cause sharps injuries.
21. List common causes of suture needle and scalpel injuries.
22. Complete guidelines for handling sharps and sharps boxes.
23. Match blunt needle categories to their selection guidelines.
24. Complete guidelines for safe blunt suturing techniques.
25. Explain the differences between Universal Precautions and Standard Precautions.
26. Complete statements concerning Standard Precautions.
27. Identify substances included in Standard Precautions that require hand protection (gloves).
28. List instances that require hand washing.
29. List CDC guidelines for proper hand washing.
30. Select true statements concerning guidelines for personal hygiene in the workplace.
31. Complete statements concerning the characteristics of radiation.
32. Match the three types of ionizing radiation to their characteristics.
33. Describe radiation safety practices.
34. State conditions that require immediate notification of the health care facility radiation safety officer.
35. Match compressed gases to their traditional U.S. cylinder colors.
36. List flammable anesthetic gases.
37. Select from a list common fire ignition sources in the operating room.
38. Match types of burns to their descriptions.
39. Discuss possible health-care related causes of patient thermal burns.
40. Select true statements concerning static electricity.
41. Complete statements concerning grounding operating room electrical equipment.
42. Discuss safeguards for preventing electrical and fire hazards in the operating room.

43. Match laser classes to their characteristics.

44. Distinguish between specular and diffuse laser beam reflections.

45. Match laser viewing hazards to their descriptions.

46. Complete statements concerning laser beam hazards to the eyes and skin.

47. Discuss precautions for using lasers safely.

48. Maneuver a wheelchair safely. (Job Sheet 1)

49. Maneuver a stretcher safely. (Job Sheet 2)

50. Demonstrate effective hand washing procedure. (Job Sheet 3)

## Information Sheet

OBJECTIVE 1 **Describe OSHA regulations required of employers.**

1. **Providing written policies and training for the safe use, handling, dispensing, and storing of hazardous materials**
2. **Following Center for Disease Control (CDC) guidelines on infection control**
3. **Providing protection from high noise levels**
4. **Providing adequate ventilation systems**
5. **Minimizing radiation exposure**
6. **Meeting standards for fire and electrical safety**
7. **Providing training in *laser* safety**

KEY TERM

**Laser**—Light amplification simulated emission of radiation; device that uses the natural oscillations of atoms or molecules between energy levels for generating coherent electromagnetic radiation, usually in the ultraviolet or infrared regions of the light spectrum

OBJECTIVE 2 **Complete statements concerning OSHA and its role in workplace health and safety.**

1. **Became federal law on April 28, 1971**
2. **Operates under the U.S. Department of Labor**
3. **Sets two major requirements for employers:**
   - To furnish each employee a place of employment free from recognized hazards that are likely to cause death or serious injury
   - To comply with the occupational safety and health standards contained within OSHA regulations
4. **Sets one major requirement for employees:**
   - To comply with occupational safety and health standards and all rules, regulations, and orders pursuant to OSHA regulations that are applicable to the employee's own actions and conduct
5. **Requires employers to keep records of their employees' occupational injuries and illnesses**

6. **Requires employers to keep material safety data sheets (MSDSs) on all hazardous substances used by employees**

7. **Often sets only minimum standards and requirements**

8. **Provides for federal OSHA officers who visit facilities and levy penalties for noncompliance**

OBJECTIVE 3 **Complete statements concerning OSHA risk factors for violence to health care workers.**

✔ **NOTE:** Health care and social service workers face an increased risk of work-related assaults stemming from the following factors.

1. **The prevalence of handguns and other weapons—as high as 25 percent—among patients, their families, or friends.**

2. **The increasing use of hospitals by police and the criminal justice systems for criminal holds and the care of acutely disturbed, violent individuals.**

3. **The increasing number of acute and chronically mentally ill patients now being released from hospitals without follow-up care, who now have the right to refuse medicine and who can no longer be hospitalized involuntarily unless they pose an immediate threat to themselves or others.**

4. **The availability of drugs or money at hospitals, clinics, and pharmacies, making them likely robbery targets.**

5. **Situational and circumstantial factors such as**

   - Unrestricted movement of the public in clinics and hospitals;
   - The increasing presence of gang members, drug or alcohol abusers, trauma patients, or distraught family members;
   - Long waits in emergency or clinic areas, leading to client frustration over an inability to obtain needed services promptly.

6. **Low staffing levels during times of specific increased activity such as meal times, visiting times, and when staff are transporting patients.**

7. **Isolated work with clients during examinations or treatment.**

8. **Solo work, often in remote locations, particularly in high-crime settings, with no back-up or means of obtaining assistance such as communication devices or alarm systems.**

9. **Lack of staff training in recognition and management of escalating hostile and assaultive behavior.**

10. **Poorly lighted parking areas**

OBJECTIVE 4 **Name the four main components to any effective safety and health program that also apply to preventing workplace violence.**

1. **Management commitment and employee involvement**

2. Worksite analysis
3. Hazard prevention and control
4. Safety and health training

**Objective 5** List responsibilities of management in creating an effective workplace violence prevention program.

1. Demonstrated organizational concern for employees' emotional and physical safety and health
2. Equal commitment to worker safety and health and patient/client safety
3. Assigned responsibility for the various aspects of the workplace violence prevention program to ensure that all managers, supervisors, and employees understand their obligations
4. Appropriate allocation of authority and resources to all responsible parties
5. A system of accountability for involved managers, supervisors, and employees
6. A comprehensive program of medical and psychological counseling and debriefing for employees experiencing or witnessing assaults and other violent incidents
7. Commitment to support and implement appropriate recommendations from safety and health committees

**Objective 6** List responsibilities of employees in creating an effective workplace violence prevention program.

1. Understanding and complying with the workplace violence prevention program and other safety and security measures
2. Participation in an employee complaint or suggestion procedure covering safety and security concerns
3. Prompt and accurate reporting of violent incidents
4. Participation on safety and health committees or teams that receive reports of violent incidents or security problems, make facility inspections, and respond with recommendations for corrective strategies
5. Taking part in a continuing education program that covers techniques to recognize escalating agitation, assaultive behavior, or criminal intent, and discusses appropriate responses

**Objective 7** Complete statements concerning OSHA-recommended engineering controls and workplace adaptation that can effectively prevent or control workplace violence hazards.

✔ **NOTE:** The selection of any measure should be based upon the hazards identified in the workplace security analysis of each facility.

1. Assess any plans for new construction or physical changes to the facility or workplace to eliminate or reduce security hazards.

2. Install and regularly maintain alarm systems and other security devices, panic buttons, hand-held alarms or noise devices, cellular phones, and private channel radios where risk is apparent or may be anticipated, and arrange for a reliable response system when an alarm is triggered.

3. Provide metal detectors—installed or hand-held, where appropriate—to identify guns, knives, or other weapons, according to the recommendations of security consultants.

4. Use a closed-circuit video recording for high-risk areas on a 24-hour basis.

   ✓ **NOTE:** Public safety is a greater concern than privacy in these situations.

5. Place curved mirrors at hallway intersections or concealed areas.

6. Enclose nurses' stations, and install deep service counters or bullet-resistant, shatter-proof glass in reception areas, triage, admitting, or client service rooms.

7. Provide employee "safe rooms" for use during emergencies.

8. Establish "time-out" or seclusion areas with high ceilings without grids for patients acting out, and establish separate rooms for criminal patients.

9. Provide client or patient waiting rooms designed to maximize comfort and minimize stress.

10. Ensure that counseling or patient care rooms have two exits.

11. Limit access to staff counseling rooms and treatment rooms controlled by using locked doors.

12. Arrange furniture to prevent entrapment of staff.

13. In interview rooms or crisis treatment areas, furniture should be minimal, lightweight, without sharp corners or edges, and/or affixed to the floor.

14. Limit the number of pictures, vases, ashtrays, or other items that can be used as weapons.

15. Provide lockable and secure bathrooms for staff members separate from patient-client, and visitor facilities.

16. Lock all unused doors to limit access, but only in strict accordance with local fire codes.

17. Install bright, effective lighting indoors and outdoors.

18. Replace burned-out lights, broken windows, and locks.

19. Keep automobiles, if used in the field, well-maintained and always locked when not in use.

**Objective 8**

**Complete statements concerning OSHA-recommended administrative and work practice controls to help prevent workplace violence.**

✔ **NOTE:** Changes in work practices and administrative procedures can help prevent violent incidents.

1. **State clearly to patients, clients, and employees that violence is not permitted or tolerated.**
2. **Establish liaison with local police and state prosecutors.**
3. **Report all incidents of violence.**
4. **Provide police with physical layouts of facilities to expedite investigations.**
5. **Require employees to report all assaults or threats to a supervisor or manager (e.g., can be confidential interview).**
6. **Keep log books and reports of all assaults or threats to help in determining any necessary actions to prevent further occurrences.**
7. **Advise and assist employees, if needed, of company procedures for requesting police assistance or filing charges when assaulted.**
8. **Provide management support during emergencies. Respond promptly to all complaints.**
9. **Set up a trained response team to respond to emergencies.**
10. **Use properly trained security officers, when necessary, to deal with aggressive behavior; follow written security procedures.**
11. **Ensure adequate and properly trained staff for restraining patients or clients.**
12. **Provide sensitive and timely information to persons waiting in line or in waiting rooms, and adopt measure to decrease waiting time.**
13. **Ensure adequate and qualified staff coverage at all times.**

    ✔ **NOTE:** Times of greatest risk occur during patient transfers, emergency responses, meal times, and at night. Locales with the greatest risk include admission units and crisis or acute care units. Other risks include admission of patients with a history of violent behavior or gang activity.

14. **Institute a sign-in procedure with passes for visitors, especially in a newborn nursery or pediatric department.**
15. **Enforce visitor hours and procedures.**
16. **Establish a list of "restricted visitors" for patients with a history of violence.**

    ✔ **NOTE:** Copies should be available at security checkpoints, nurses' stations, and visitor sign-in areas.

17. **Review and revise visitor check systems, when necessary.**

**18. Limit information given to outsiders on hospitalized victims of violence.**

**19. Supervise the movement of psychiatric clients and patients throughout the facility.**

**20. Control access to areas other than waiting rooms, particularly drug storage or pharmacy areas.**

**21. Prohibit employees from working alone in emergency areas or walk-in clinics, particularly at night or when assistance is unavailable.**

**22. Never allow employees to enter seclusion rooms alone.**

**23. Establish policies and procedures for secured areas, and emergency evacuations, and for monitoring high-risk patients at night (e.g., open versus locked seclusion).**

**24. Ascertain the behavioral history of new and transferred patients to learn about any past violent or assaultive behaviors. Establish a system—such as chart tags, log books, or verbal census reports—to identify patients and clients with assaultive behavior problems, keeping in mind patient confidentiality and worker safety issues; update as needed.**

**25. Treat and/or interview aggressive or agitated clients in relatively open areas that still maintain privacy and confidentiality.**

**26. Use case management conferences with co-workers and supervisors to discuss ways to effectively treat potentially violent patients.**

**27. Prepare contingency plans to treat clients who are "acting out" or making verbal or physical attacks or threats.**

✔ **NOTE:** Consider using certified employee assistance professionals (CEAPs) or in-house social service or occupational health service staff to help diffuse patient or client anger.

**28. Transfer assaultive clients to "acute care units," "criminal units," or other more restrictive settings.**

**29. Make sure that nurses and/or physicians are not alone when performing intimate physical examinations of patients.**

**30. Discourage employees from wearing jewelry to help prevent possible strangulation in confrontational situations.**

✔ **NOTE:** Community workers should carry only required identification and money.

**31. Periodically survey the facility to remove tools or possessions left by visitors or maintenance staff which could be used inappropriately by patients.**

**32. Provide staff with identification badges, preferably without last names, to readily verify employment.**

**33. Discourage employees from carrying keys, pens, or other items that could be used as weapons.**

34. **Provide staff members with security escorts to parking areas in evening or late hours. Parking areas should be highly visible, well-lighted, and safely accessible to the building.**

35. **Use the "buddy system," especially when personal safety may be threatened.**

36. **Encourage home health care providers, social service workers, and others to avoid threatening situations.**

37. **Caution staff to exercise extra care in elevators, stairwells and unfamiliar residences, telling them to immediately leave premises if there is a hazardous situation; or to request police escort if needed.**

38. **Develop policies and procedures covering home health care providers, such as contracts on how visits will be conducted, the presence of others in the home during the visits, and the refusal to provide services in a clearly hazardous situation.**

39. **Establish a daily work plan for field staff to keep a designated contact person informed about workers' whereabouts throughout the workday. If an employee does not report in, the contact person should follow up.**

40. **Conduct a comprehensive post-incident evaluation, including psychological as well as medical treatment, for employees who have been subjected to abusive behavior.**

OBJECTIVE 9 **List records that are important to the success of a workplace violence prevention program.**

✔ **NOTE:** Recordkeeping is essential to the success of a workplace violence prevention program. Good records help employers determine the severity of the problem, evaluate methods of hazard control, and identify training needs.

1. **OSHA Log of Injury and Illness (OSHA 200)**

   ✔ **NOTE:** OSHA regulations require entry on the Injury and Illness Log of any injury that requires more than first aid, is a lost-time injury, requires modified duty, or causes loss of consciousness. (This applies only to establishments required to keep OSHA logs.) Injuries caused by assaults, which are otherwise recordable, also must be entered on the log. A fatality or catastrophe that results in the hospitalization of three or more employees must be *reported to OSHA within eight hours*. This includes those resulting from workplace violence and applies to *all* establishments.

2. **Medical reports of all work injury and supervisors' reports for each recorded assault**

3. **Incidents of abuse, verbal attacks or aggressive behavior—which may be threatening to the worker but do not result in injury, such as pushing or shouting and acts of aggression towards other clients—should be recorded, perhaps as part of an assaultive incident report.**

4. **Information on patients with a history of past violence, drug abuse, or criminal activity**

   ✔ **NOTE:** Such information should be recorded on the patient's chart.

5. **Minutes of safety meetings, records of hazard analyses, and corrective actions recommended and taken**

6. **Records of all training programs, attendees, and qualifications of trainers**

OBJECTIVE 10

**Select true statements concerning hazard communications.**

1. **OSHA requires employers to develop written Haz Com program including**
    - Warning labels on containers
    - Material Safety Data Sheets (MSDS) readily available to employees, and
    - Employee training on the proper handling, usage, storage, and transportation of chemicals.
2. **OSHA established the Haz Com Standard to protect the health and safety of employees.**
3. **The Haz Com standard ensures the employees "right to know" about potentially dangerous chemicals in the workplace.**

OBJECTIVE 11

**List the information found on a chemical label.**

✔ **NOTE:** Never use a chemical without reading its label. If the label is missing, immediately notify your instructor or supervisor.

1. **Chemical name**
2. **Chemical ingredients**
3. **Name, address, and phone number of manufacturer or distributor**
4. **Procedures for safe use, handling, storage, and disposal**
5. **How to handle spills and leaks**
6. **Signal words that identify the chemical's hazard level**
    - Caution—Least severe
    - Warning—Very severe
    - Danger—Most severe
7. **Critical first-aid instructions and type of fire extinguisher to use**
8. **Personal protective equipment to wear when using the chemical**
9. **Other information about the chemical**
    - Flammability
    - Radioactivity

- Reactivity

  Examples: Uses words such as **incompatible**, **unstable**, and **volatile**

- Toxicity

KEY TERMS

**Incompatible**—Unsuitable for use together with another substance

**Unstable**—Readily changing in chemical composition such as through decomposition

**Volatile**—Subject to rapid or unexpected change such as an explosion

OBJECTIVE 12 **Complete basic healthcare workplace safety guidelines.**

1. **Use good body mechanics.**
2. **Walk; avoid running.**
3. **Keep to the right in hallways.**
4. **Turn corners carefully, slowing and checking ceiling mirrors on intersecting walls.**
5. **Open doors slowly, checking the other side of swinging doors that have glass inserts.**
6. **Use stretchers properly.**
   - Push, don't pull, the stretcher.
   - Keep patient's head toward your body.

     ✔ **NOTE:** Protect the head because it is more vulnerable than the feet to impact injury.

   - Keep your eyes to the front at all times.
7. **Use brakes on beds, wheelchairs, and stretchers.**
8. **Place elevators on HOLD when loading and unloading.**
9. **When handling an occupied wheelchair, back into the elevator, pulling the wheelchair in after you.**
10. **Never manually recap contaminated needles.**

    ✔ **NOTE:** This is an OSHA regulation. Employees manually recapping contaminated needles are considered in violation of the OSHA regulation. If this action were documented by an inspector, the employing agency could be cited and fined.

### OBJECTIVE 13

**Match personal protective equipment (PPE) to their protective requirements.**

✔ **NOTE:** OSHA regulations state that acceptable PPE protection be used. The surgical technician and others in the operating room, however, must wear PPE that provides *effective* protection with all patients.

1. **Headwear**—Must effectively repel blood and body fluids

2. **Neckwear**—May be an appropriate additional precaution in cases where the patient is a known carrier of bloodborne pathogens

   Examples: A face shield with integrated neck protection, neck cowling, or a hooded face shield

3. **Eye and face protection**—Must be uniform, effective and worn by all O.R. personnel

   Examples: Face shields, goggles/special eye glasses, mask/shield combinations

   ✔ **NOTE:** Health care worker's eyes have been identified as being the most vulnerable location for serious blood exposures.

   ⚠ **CAUTION:** Splashes of blood have occurred during removal and disposal of gloves and other contaminated items. For this reason eye protection and masks should be worn during the *entire* procedure.

4. **"Space suits"**—Have become popular for orthopedic procedures because blood spatters and bone chips created by power tools present a special hazard

   Example: Hooded face shield

5. **Surgical gowns**—Should be selected to match the expected degree of exposure

   - **Fluid-resistant gown**—Use for procedures with low risk for exposure, such as ophthalmic surgery.
   - **"Strikethrough" gown**—Use for procedures associated with significant blood loss and prolonged duration.
   - **Impervious gown**—Use when massive blood or fluid contamination is expected.

KEY TERMS

**Fluid-resistant gown**—Gown of adequate length that resists fluid penetration but is not totally waterproof

**"Strikethrough" gown**—Gown having adequate length and maximum impermeability

**Impervious gown**—Coated, nonporous gown that extends below the top of knee-high foot covers or boots

6. **Hand protection**—Routinely double-glove and, if necessary to protect the cuff area, wear elbow-length gloves when significant or massive blood loss and prolonged duration is expected.

   ⚠ **CAUTION:** Carefully remove gloves one layer at a time to avoid splashes to personnel. Never "shoot" gloves into the trash container. This dangerous practice has caused exposures to the eyes of nearby health care workers.

7. **Footwear/shoe covers**—Fluid-resistant disposable shoe covers are helpful in preventing exposures; **trauma boots** are appropriate for obstetrical procedures and other procedures that pose a high risk of exposure to bloodborne pathogens

KEY TERM

**Trauma boots**—Knee-high shoe covers

8. **Surgical drape selection**—Select to match the expected degree of exposure

   ✓ **NOTE:** While impervious drapes might seem like the best choice, they cause more runoff. For this reason, it may be wiser to select a drape with an integrated waterproof pouch. Such drapes have several advantages: They protect personnel against exposure; they prevent gross contamination of the room; and they shorten room turnover time.

OBJECTIVE 14

**Match types of reactions to latex to their characteristics.**

1. **Irritant dermatitis**
   - Is a skin irritation that does not involve the body's immune response, so is not an allergic response
   - Can be caused by frequent hand washing and inadequate drying, aggressive scrubbing technique or detergents, mechanical abrasive effect of glove powder, climatic irritation (cold climates can cause dry, chapped skin and hot weather can cause excessive sweating), or emotional stress
   - Can cause breaks in the skin which can allow easier entry of the sensitizing latex protein or glove chemicals, and in turn lead to **latex allergy**
2. **Delayed cutaneous hypersensitivity (type IV allergy)**
   - Is a contact (hand) dermatitis typically seen 6 to 48 hours after contact and generally due to the chemicals used in latex glove production
   - Is not life threatening, but those with type IV allergy are at increased risk to develop type I allergy
3. **Immediate reaction (type I allergy)**
   - Is a **systemic** allergic reaction usually occurring within 30 minutes of exposure and caused by circulating **IgE antibodies** to the proteins in natural latex.
   - Can exhibit such symptoms as hives, **rhinitis**, **conjunctivitis**, asthma due to **bronchoconstriction**, and in severe cases **anaphylaxis** and **hypotension**.

- Includes the following exposure routes that can lead to type I sensitivity; cutaneous, **mucosal**, **parenteral**, and aerosol (from inhaling latex glove powder)

KEY TERMS

**Latex allergy**—A reaction to certain proteins in latex rubber

**Cutaneous**—Through the skin

**Systemic**—Affecting the entire body

**IgE antibodies**—A class of immunoglobins that function in allergic reactions

**Rhinitis**—Inflammation of the mucous membrane of the nose

**Conjunctivitis**—Eye infection

**Bronchoconstriction**—Constriction of the bronchi

**Anaphylaxis**—Systemic allergic reaction

**Hypotension**—Abnormally low blood pressure

**Mucosal**—Through the mucous membranes

**Parenteral**—Administered into the body in a manner other than through the digestive (enteral) tract

OBJECTIVE 15

**List ways of preventing latex allergy.**

1. **Use nonlatex gloves for activities unlikely to involve contact with infectious materials.**

   ✓ **NOTE:** Proteins from the latex transfer from the latex to the powder. While donning and removing powdered gloves, the protein coated particles become airborne and can contaminate large volumes. Glove manufacturers try to avoid powder by creating a powder-free or powder-reduced glove.

2. **If you choose latex gloves, use powder-free gloves with reduced protein content.**

   ✓ **NOTE:** Such gloves reduce exposures to latex protein and thus reduce the risk of latex allergy. So called "hypoallergenic" latex gloves do not reduce the risk of latex allergy. However, they may reduce reactions to chemical additives in the latex (allergic contact dermatitis).

3. **Report any hand rash for evaluation for possible latex allergy.**

4. **Use appropriate work practices to reduce the chance of reactions to latex.**

   - When wearing latex gloves, do not use oil-based hand creams or lotions; these can cause glove deterioration.
   - Minimize skin contact time with potential allergens by removing gloves promptly when completing a procedure.
   - After removing latex gloves, wash hands with a mild soap and dry thoroughly.

   - Practice good housekeeping: frequently clean areas and equipment contaminated with latex-containing dust.
   - Change ventilation filters and vacuum bags frequently in areas identified as prone to latex dust.
   - Do not store latex gloves under conditions of excess heat or light, or near sources of ionizing radiation, since this will cause more rapid rubber deterioration.
   - Avoid touching your eyes, nose, or mouth while wearing latex or immediately upon removing a latex glove, in order to avoid potential latex sensitization via these routes.

5. **Take advantage of all latex allergy education and training provided by your employer and become familiar with procedures for preventing latex allergy.**
6. **Learn to recognize the symptoms of latex allergy: skin rash, hives, flushing, itching, nasal, eye, or sinus symptoms, asthma, and (rarely) shock.**

OBJECTIVE 16

**Complete statements concerning bloodborne pathogens.**

1. **Bloodborne pathogens are microorganisms in the bloodstream that can cause disease.**
2. **The most common bloodborne pathogens that concern operating room professionals are hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV).**
3. **Bloodborne pathogens are found in contaminated blood, body fluids including semen, vaginal secretions, breast milk, and cerebrospinal fluid, as well as in tissue cultures.**

   ✔ **NOTE:** Although these organisms may be found in all body fluids, in many cases they are not strong enough to be transmitted.

4. **In order for an infection to occur, both the source blood must be infected and the infected blood must enter another person's bloodstream through one of the following routes:**
   - Unprotected opening in the skin such as cuts, scrapes, and dermatitis,
   - Unprotected mucous membrane openings such as the eyes, nose, and mouth
   - Penetration into the skin by a sharp object such as a broken glass, a needle or knife blade

OBJECTIVE 17

**Select true statements concerning the five different types of hepatitis.**

1. **Hepatitis A (HAV)**
   - Is a liver disease caused by the hepatitis A virus
   - Can affect anyone
   - In the U.S., can occur in situations ranging from isolated cases of disease to widespread epidemics
   - Is transmitted through contact with the **feces** of an infected person

- Can aid prevention by using good personal hygiene and proper sanitation
- Can be prevented by long-term vaccination if patient is 2 years old and older
- Can receive immune globulin for short-term prevention in all ages

2. **Hepatitis B (HBV)**
   - Is a serious disease caused by a virus that attacks the liver
   - Can cause lifelong infection, cirrhosis (scarring) of the liver, liver cancer, liver failure, and death
   - Is transmitted by direct contact with blood or body fluids of an infected person
   - Can be symptomless, infected persons carrying the disease and infecting others without knowing it; only a blood test can tell for sure
   - Can be prevented with vaccine available for all age groups
3. **Hepatitis C (HCV)**
   - Is a liver disease caused by the hepatitis C virus
   - Is found in the blood of persons who have the disease
   - Is transmitted by contact with the blood or body fluids of an infected person
4. **Hepatitis D (HDV)**
   - Is a defective virus that needs the hepatitis B virus to exist
   - Is found in the blood of persons infected with HDV
   - Can be acquired either as a **co-infection** with HBV or as a **superinfection** of persons with **chronic** HBV infection
   - Is transmitted similarly to transmission of HBV, with percutaneous exposures (drug use) the most efficient, sexual transmission less efficient than for HBV, and perinatal HDV transmission rare
   - Can lead to chronic liver disease and cirrhosis of the liver

   ✔ **NOTE:** In long-term studies of chronic HBV carriers with HDV superinfection, 70%–80% have developed evidence of chronic liver diseases with cirrhosis compared with 15%–30% of patients with chronic HBV infection alone.
5. **Hepatitis E (HEV)**
   - Is a virus transmitted in much the same way as hepatitis A virus
   - Does not often occur in the United States
   - Is associated with fecal-oral route and fecally contaminated drinking water in most outbreaks
   - Is minimally contracted through person-to-person transmission
   - U.S. cases usually have history of travel to HEV-**endemic** areas

KEY TERMS

**Feces**—Waste excreted from the bowels; stool

**Co-infection**—Infected by two microbial agents, such as a virus, at the same time

**Superinfection**—Reinfection or a second infection with a microbial agent such as a virus

**Chronic**—Marked by long duration or frequent recurrence; not acute

**Endemic**—Characteristic of or prevalent in a particular environment

OBJECTIVE 18

**Select true statements concerning bloodborne pathogens and their concern to operating room professionals.**

1. **Hepatitis B virus (HBV)**
    - Carries 6% to 30% risk of acquiring hepatitis B from a needlestick injury with HBV-contaminated blood
    - Is present in high ratios in the blood: 1 ml of contaminated blood contains 1 billion hepatitis virus
    - Can live up to seven days on dry surfaces
    - Is seldom fatal but can become chronic, results in months of disability
    - Has high potential for viral spread to others
    - Requires that all operating room professionals be vaccinated with hepatitis B vaccine (pre-exposure and post-exposure) and B immune globulin (temporary passive protection, post-exposure) for effective protection

      ✔ **NOTE:** The CDC reports that vaccinations are effective for up to 14 years.
2. **Hepatitis C virus (HCV)**
    - Is a highly significant occupational health risk to operating room professionals
    - Is harbored by up to 18% of emergency room patients
    - Has been transmitted via needlestick and blood splash to the conjunctiva
    - Has an extremely high rate of chronic infection (85%)
    - Mutates rapidly thus yielding multiple opportunities for infection and reinfection
    - Because it is a mutating virus, researchers have been unable to find a cure or vaccine
    - About 20% of those chronically infected develop end-stage cirrhosis, liver failure, and liver cancer

- Is the leading cause for liver transplants in the U.S.
- Has a high mortality rate

3. **Human immunodeficiency virus (HIV)**

- Is caused by sharps injuries in more than 80% of occupationally acquired cases
- Most sharps transmittals involve hollow-bore needles
- May infect a person for years before the symptoms of **AIDs (acquired immunodeficiency syndrome)** appear
- Permits opportunistic infections, malignancies, and neurologic diseases to attack the body

  Examples: Karposi's sarcoma, lymphoma of the brain, certain types of pneumonia

  ✔ **NOTE:** When these conditions occur, a diagnosis of AIDS is made.

- Mutates rapidly thus yielding multiple opportunities for infection and reinfection
- Because it is a mutating virus, researchers have been unable to find a cure or vaccine
- Is a deadly virus

KEY TERMS

**HIV (Human Immunodeficiency Virus)**—Virus that attacks the body's immune system generally resulting in AIDS

**AIDS (Acquired Immunodeficiency Syndrome)**—Generally lethal disease that renders the subject highly susceptible to life-threatening conditions, including opportunistic infections, malignancies, and neurologic diseases such as lymphoma of the brain, Kaposi's sarcoma, certain types of pneumonia, and others

**OBJECTIVE 19** **Complete a chart comparing HIV and HBV.**

| | HIV | HBV |
|---|---|---|
| **Transmission** | Sexual contact<br>Parenteral<br>Perinatal | Sexual contact<br>Parenteral<br>Perinatal |
| **Incubation** | 5–6 days to get through blood stream<br>2 weeks to 2 months to show positive test<br>Up to 10+ years asymptomatic | 40–180 days |
| **Symptoms** | HIV + (asymptomatic)<br>American Red Cross flu symptoms<br>Aids opportunistic diseases | One-third of patients asymptomatic<br>Flu symptoms<br>Acute jaundice |
| **Prognosis** | Death | Complete recovery, 6 months<br>Chronic carrier<br>Complications such as<br>• Cirrhosis<br>• Liver cancer<br>• Chronic liver disease<br>Death |

**OBJECTIVE 20** **List examples of devices that can cause sharps injuries.**

✔ **NOTE:** The majority of sharps injuries occur in the operating room. Logically, the devices that most often cause glove perforations and sharps injuries in the operating room are suture needles and scalpels; however, there are many other sharps devices that can cause these injuries and exposures also.

1. **Wire sutures**
2. **Hollow injection needles**
3. **Guide wires**
4. **Stylets**
5. **Drain trocars**
6. **Laparoscopic trocars**
7. **Orthopedic drill bits, screws, pins, wires, and saws**
8. **Urethral suspension needles**
9. **Needle point cautery tips**

10. **Microscissors and other sharp pointed scissors**
11. **Sharp pointed retractors**
12. **Skin hooks**
13. **Penetrating towel clips**
14. **Tenaculi**
15. **Thyroid clamps**
16. **Broken glass instruments and vials**
17. **Syringes**

KEY TERM

**Sharps**—Devices with a sharp point, blade, or edge that may cause injury

OBJECTIVE 21

**List common causes of suture needle and scalpel injuries.**

✓ **NOTE:** All sharps should have a designated safe location (Neutral Zone) during passing and between uses.

1. **Assembling and disassembling scalpel**
2. **Mounting needle in needle holder**
3. **Repositioning needle in needle holder**
4. **Passing needle or scalpel hand to hand between team members**
5. **Suturing and cutting**
    - Using fingers as a backstop or to guide needle during suturing
    - Holding tissue with the hand during suturing
    - Cutting toward fingers of surgeon or assistant
    - Protecting structures adjacent to surgeon's suturing with hand
6. **Retracting wound tissue manually**
7. **Tying while needle is attached**
8. **Leaving needle on field while tying**
9. **Holding needle in hand or needle holder while tying**
10. **Before and after using on the field**
    - Needle or scalpel left on field contacts worker's hand

- Dropping needle or scalpel on worker's foot
- Reaching for device sliding off drapes

11. **Placing needle or scalpel in poorly designed, overfilled, or improperly positioned disposal container or in container with too small an opening**

OBJECTIVE 22 **Complete guidelines for handling sharps and sharps boxes.**

1. **Use a Neutral Zone (Safe Zone).**
2. **Assemble and disassemble sharps devices in a safe and unhurried manner.**
3. **Mount and remove scalpel blades and needles with safety devices designed for that purpose or with a hemostat—never with the fingers.**
4. **Use extreme care when assembling or dismantling devices with sharp components that require the use of both hands and an opposing push/pull method.**
5. **Avoid recapping needles by directly disposing of them.**
6. **Place the sharps containers within arm's reach of work area.**
7. **If needles must be reused during a procedure for incremental injection, use safety-engineered recapping devices or long-handled instruments, never the fingers.**

   ✔ **NOTE:** Another option for handling needles between uses is to stick the needle into a towel rolled as a tube.

8. **Keep both hands behind the needle or scalpel.**
9. **Choose a sharps container with an opening large enough for the intended device.**
10. **Ensure that the opening to the sharps container is unobstructed.**
11. **Avoid overfilling the sharps container.**
12. **Never reach into a sharps disposal container—either with fingers or instruments.**
13. **Designate and understand whose responsibility it is to change the sharps container when it is full.**
14. **Avoid unnecessary "assisting" by keeping hands away from the incision during cutting and suturing.**
15. **Do not lean over the incision when suturing or cutting is taking place.**

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**OBJECTIVE 23**

**Match blunt needle categories to their selection guidelines.**

✔ **NOTE:** Preference for blunt needles, blunt sutures, blunt retractors and other safety devices should appear on the surgeon's preference card. This helps ensure that these instruments are available at the beginning of the procedure.

1. **Least blunt needles**—Work well for most applications, with the exception of bowel anastomosis
2. **Intermediate blunt needles**—Require a little more effort to penetrate tissue such as fascia; may be chosen for fascial closure and for increased protection of the gloves and fingers when operating on patients with known bloodborne pathogens
3. **Extremely blunt needles**—Do not penetrate tissue such as the fascia easily and should not be used for this purpose; may be appropriate in unusual situations in pelvic and abdominal surgery where the needle absolutely must be retrieved with the fingers

**OBJECTIVE 24**

**Complete guidelines for safe blunting suturing techniques.**

✔ **NOTE:** The blunter the tip, the more important it is to follow these points of technique.

1. **Use a strong needle holder and fully activate the lock.**
2. **Mount the needle in the mid-curve rather than three-quarters of the way back, to prevent slippage or bending of the needle.**
3. **Grasp and stabilize the tissue to be sutured to facilitate needle penetration.**
4. **Avoid manual handling of any and all suture needles, whether blunt or sharp.**
5. **Know that blunt GI needles made of thin-gauge wire with a thin point can cause *percutaneous* injury if a blow to the skin is delivered with force.**
6. **Know that blunt needles of general closure size, especially those with minimally blunt points, can cause a puncture if a blow to the skin is delivered with force.**
7. **Avoid needle breakage, by not using thin-gauge needles with dense tissue.**
8. **Carefully read labels on suture packs to verify that blunt rather than sharp needles were pulled.**

KEY TERM

**Percutaneous**—Skin penetrating

**OBJECTIVE 25** **Explain the differences between Universal Precautions and Standard Precautions.**

1. **Universal Precautions**—Basic guidelines for infection control published in 1988 by the Centers for Disease Control and Prevention (CDC); if followed, the guidelines protect healthcare workers against contact with blood and body fluids that transmit bloodborne pathogens
2. **Standard Precautions**—New set of guidelines for infection control released by the Centers for Disease Control and Prevention (CDC) in 1994; guidelines are expanded to include gloves for all contact with feces, urine, nasal secretions, vomitus, and sputum to decrease the transmission of viruses found in these substances

**OBJECTIVE 26** **Complete statements concerning Standard Precautions.**

1. **Wear clean latex or vinyl gloves whenever there is potential for contact with body fluids or any moist body surface.**
2. **Know the specific situations in which gloves are recommended by the CDC because the potential for contact with body substances is high.**
    - Performing phlebotomy
    - Performing finger or heel sticks in infants and children
    - Performing procedures involving contact with mucous membranes and diagnostic procedures that do not require sterile gloves
    - Changing or manipulating IV lines when blood contamination is possible
    - Handling dressings soiled with body fluids
    - Handling urine or feces
    - Providing care (such as perineal care) that could result in contact with moist surfaces or body fluids
3. **Change gloves between patient contacts.**
4. **Do not wash or clean examination gloves.**
5. **Wash your hands thoroughly.**
    - Immediately after accidental contact with body substances or moist body surfaces.
    - Between patients, and
    - Immediately after removing gloves.
6. **Wear a mask and protective eyewear or a face shield to protect the mucous membranes of your mouth, nose, and eyes during procedures that may generate droplets or splashes of any body fluid.**
7. **Wear a disposable moisture-proof apron or gown during procedures likely to generate splatters of body fluid or soil your clothing.**

8. **Dispose of equipment and secretions properly**
   - Sharps in sharps containers;
   - Bulk blood, suctioned fluids, and excretions down drains to sewer.

   ✓ **NOTE:** The sanitary sewer system is designed to prevent pathogens from contact in people in the community.

9. **Put all specimens in moisture-proof containers with secure lids to prevent leakage during transport, taking care to prevent contaminating the outside of the container to protect those who will handle the container.**

10. **Handle soiled linen correctly.**
    - Hold away from your uniform,
    - Do not shake or toss, and
    - Place and transport linen soiled with body fluids in leakage-resistant bags.

11. **Follow your facility's policies for cleaning contaminated surfaces and materials and for disposing of infective wastes.**

12. **Clean visible soil from objects and surfaces before disinfection.**

    ✓ **NOTE:** Pathogens can live inside or under visible soil despite contact with disinfectants.

13. **Use a commercial germicide solution for cleaning.**

    ✓ **NOTE:** In the absence of a commercial germicide, household bleach in a 1:10 dilution is effective as a disinfectant.

14. **Use mouthpieces, resuscitation bags, or other ventilation devices for cardiopulmonary resuscitation (CPR) whenever possible.**

    ✓ **NOTE:** Saliva has not been implicated in HIV transmission, but other infections are transmitted by saliva.

15. **If you have a lesion, refrain from all direct patient care and from handling patient care equipment until the lesion is resolved.**

OBJECTIVE 27

**Identify substances included in Standard Precautions that require hand protection (gloves).**

✓ **NOTE:** Wear gloves for all body fluids, excretions, or secretions, regardless of whether or not they contain visible blood.

1. **Blood**
2. **Sputum**
3. **Urine**
4. **Feces**

5. Nasal secretions
6. Vomitus
7. Spinal fluid
8. Semen
9. Cerebrospinal fluid
10. Synovial fluid
11. Pleural fluid
12. Peritoneal fluid
13. Pericardial fluid
14. Amniotic fluid
15. Nonintact skin
16. Mucous membranes

OBJECTIVE 28 List instances that require hand washing.

1. At the beginning of every work shift
2. Before and after prolonged contact with patient
3. Before invasive procedures
4. Before contact with especially susceptible patients
5. Before and after touching wounds
6. After contact with body substances, even when gloves are worn
7. Any time you are in doubt about the necessity for doing so
8. At the end of every shift before leaving the health care facility

OBJECTIVE 29 List CDC guidelines for proper hand washing.

1. For medical and aseptic purposes, perform at least a vigorous 10-second hand washing that includes "rubbing together all surfaces of lathered hands followed by rinsing in a stream of water."
2. For medical and aseptic purposes when the hands are visibly soiled, take more than 10-seconds to perform hand washing procedure.

   ✔ **NOTE:** Some medical professionals prefer to use a 30-second hand wash all of the time as an extra precaution.

3. Use friction, running water, and a cleansing agent when washing hands.

4. **Plain liquid or powdered soap as a cleansing agent is adequate in all situations but those requiring antimicrobial products.**

5. **If bar soap is the only type available, later and rinse the bar thoroughly to remove the outside layer of soap before you use it.**

   ✔ **NOTE:** Bar soap is not recommended because it may harbor microorganisms.

6. **Use antimicrobial products as cleansing agents when washing hands in the following situations:**

   - Newborn care
   - Between patients in high-risk units
   - Before the care of immunosuppressed patients

7. **When possible use a deep sink operated by foot, leg, or elbow controls.**

8. **Where faucets are operated by hand, use a dry paper towel to turn off the water because a dirty hand was used to turn it on.**

9. **Because hand washing procedure causes microorganisms to accumulate in the sink, avoid touching the sink as you wash and avoid splashing dirty water on your uniform.**

10. **It is not necessary to clean your nails each time you wash your hands; clean under your fingernails before you leave home if a nail file or orangewood stick is not available at the hand washing site.**

OBJECTIVE 30 **Select true statements concerning the workplace.**

1. **Keep your hair short or restrain it so that it cannot fall forward.**

2. **Choose a hair style that does not require you to constantly touch your hair with your hands to brush it out of your eyes or back from your face.**

3. **Keep your fingernails clean and trimmed or filed short.**

4. **If you use polish, ensure that it is intact; chipped polish provides a place for bacteria to lodge.**

5. **Wear only the minimum jewelry, at most only a watch, plain post or stud earrings, and a plain wedding band.**

   ✔ **NOTE:** Wear no jewelry when laser procedures will be performed.

6. **Do not wear necklaces or hoop earrings.**

   ✔ **NOTE:** Necklaces and dangling earrings not only provide a surface for contamination, but patients may grab them and hurt you and the jewelry.

7. **Do not wear eyebrow, nose, tongue, or other body piercing jewelry.**

OBJECTIVE 31 **Complete statements concerning the characteristics of radiation.**

1. **Radiation waves and particles are used therapeutically for diagnosis (*X-rays*) and treatment of cancer (radioisotopes and other radioactive sources).**

2. **Exposure to ionizing radiation should be limited because it has the ability to penetrate cells and change them.**

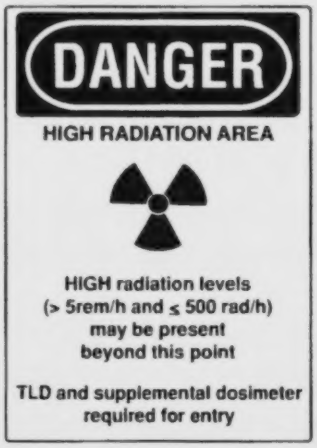
3. **Radiation effects are directly related to the amount and duration of exposure.**

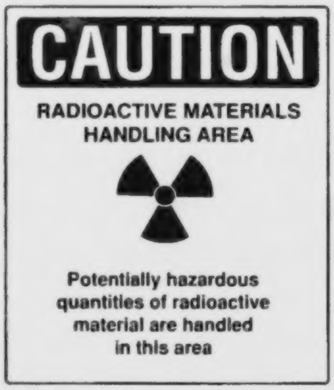
4. **The effects of radiation exposure may not become evident for years.**

5. **Overexposure to radiation can result in illnesses ranging from the mild to lethal.**

   - **Mild effects**—Anorexia, headache, nausea, vomiting, diarrhea
   - **Delayed effects from repeated or prolonged exposure—Amenorrhea**, sterility, disturbances in blood cell formation, **cataracts**, **carcinogenesis**, **leukemia**
   - **Serious effects from massive radiation exposure (accident or atomic bomb)**—Tissue necrosis (death), extensive hemorrhages, bone marrow injury, loss of hair and teeth, genetic changes, death

6. **The universal symbol used to identify radioactive materials, containers, and storage areas is a purple or black propeller on a yellow background (Figures 3 and 4); it should not be confused with the symbol for a fallout shelter.**


DANGER
HIGH RADIATION AREA
HIGH radiation levels
(> 5rem/h and ≤ 500 rad/h)
may be present
beyond this point
TLD and supplemental dosimeter
required for entry


CAUTION
RADIOACTIVE MATERIALS
HANDLING AREA
Potentially hazardous
quantities of radioactive
material are handled
in this area

KEY TERMS

**X-ray**—High energy electromagnetic wave capable of affecting photographic plates

**Amenorrhea**—Abnormal absence or suppression of menses (menstrual flow)

**Cataract**—A clouding of the lens of the eye or its surrounding transparent membrane that obstructs the passage of light

**Carcinogenesis**—The production of cancer

**Leukemia**—An acute or chronic disease characterized by the abnormal increase in the number of white blood cells in the tissues and blood

OBJECTIVE 32

**Match the three types of ionizing radiation to their characteristics.**

✔ **NOTE:** There are three main types of ionizing radiation. They may be found in sources of man-made radiation as well as natural radiation sources.

1. **Alpha**

   - **_Alpha particles_ can be prevented from penetrating the body by a sheet of paper or by human skin.**
   - **If _radionuclides_ that emit alpha particles are inhaled, ingested, or enter the body through a cut in the skin, however, they can be very harmful.**

2. **Beta**

   - **_Beta particles_ cannot be stopped by a sheet of paper, and though some beta particles can be stopped by human skin, other need a thicker shield (like wood) to stop them.**
   - **Just like alpha particles, beta particles can also cause serious damage to one's health if they enter the body.**

     Example: If ingested, some radionuclides that emit beta particles might be absorbed into the bones and cause damage.

3. **Gamma**

   - **_Gamma rays_ are the most penetrating of the three types of radiation.**
   - **Gamma rays usually accompany beta and some alpha rays.**
   - **Gamma rays will penetrate paper, skin, wood, and other substances.**

     ✔ **NOTE:** To protect yourself from gamma rays, you need a shield at least as thick as a concrete wall.

   - **Gamma radiation can cause severe damage to the internal organs.**

     ✔ **NOTE:** X-rays fall into this category, but they are less penetrating than gamma rays.

KEY TERMS

**Alpha particle**—A positively charged particle made up of two neutrons and two protons emitted by certain radioactive nuclei

**Radionuclide**—A radioactive species of an atom having a characteristic nucleus

**Beta particle**—An electron or positron emitted by certain radioactive nuclei

**Gamma rays**—High-energy electromagnetic radiation emitted by certain radioactive nuclei; these rays have high energy and a short wave length

**OBJECTIVE 33** **Describe radiation safety practices.**

1. **Patient safety**
   - Shield body areas from scatter radiation.
   - Take an X-ray for a lost sponge or needle only after a thorough search has been made.
   - Turn off the fluoroscope and other equipment when not in use.
   - Use lead shields to protect the reproductive organs of all women, whether or not they are pregnant.
   - At least annually test all shielding devices such as lead aprons, thyroid shields, and gloves used for radiation protection during X-ray procedures.
2. **Personnel safety**
   - When possible, rotate assignments on procedures that involve radiation.
   - Turn off machines when not in use.
   - Leave radioactive elements in lead-lined containers until ready to use.
   - Use protective shields and equipment when necessary.
   - Use a monitoring device to measure accumulated exposure to radiation.

**OBJECTIVE 34** **State conditions that require immediate notification of the health care facility radiation safety officer.**

1. **Radioactive contamination outside a licensed area**
2. **Deliberate misuse of radioactive materials**
3. **Known or suspected personnel contamination, inhalation, injection, or ingestion of radioactive material**
4. **Any accident resulting in direct exposure to personnel**
5. **Known or suspected loss of radioactive material, including loss to the air or sewer**
6. **Contaminated or damaged radioactive material shipments**

**OBJECTIVE 35** **Match compressed gases to their traditional U.S. cylinder colors.**

⚠ **CAUTION:** Traditionally, medical gas tanks are color-coded, but the surgical technologist must realize that this isn't always the case and must also realize that international colors may differ from the U.S. color codes. In safety tips for handling compressed gas, the CGA cautions, "It is essential that any person handling a container of compressed gas be certain of the contents before the container is connected to a system." CGA further cautions that workers should be sure "the container is clearly and properly marked or labeled with the identification of the contents and there are no conflicting markings, labels, or coloring. Do not rely solely on the color of the container to identify the contents. If there is any doubt about the contents, do not use the container."

1. **Oxygen—Green (white, international)**
2. **Nitrous oxide—Blue**
3. **Carbon dioxide—Gray**
4. **Nitrogen—Black**
5. **Helium—Brown**
6. **Cyclopropane—Orange**
7. **Air—Yellow (black & white, international)**

**OBJECTIVE 36** **List flammable anesthetic gases.**

✔ **NOTE:** While a few health care facilities continue to use **flammable anesthetics**, most—through widespread adherence to the provisions of 12-4.1 of NFPA 99, Standard for Health Care Facilities—have abandoned the use of flammable anesthetic gases. However, the operating room environment continues to present fire hazards because the reduction in use of flammable anesthetics in operating rooms has allowed for increased use of potential ignition sources, such as electrosurgical units and lasers. Advances in materials science have also introduced polymers (endotracheal tube) and fabrics (drapes and gowns) that are flammable in the oxygen-enriched atmosphere of operating rooms.

1. **Cyclopropane**
2. **Divinyl ether**
3. **Ethyl ether**
4. **Ethyl chloride**
5. **Ethylene**

KEY TERM

**Flammable anesthetic**—A compressed gas which is flammable and administered as an anesthetic, including among others the ethers, oxygen, and nitrous oxide

**OBJECTIVE 37** **Select from a list common fire ignition sources in the operating room.**

1. **High intensity light cords**

   ✔ **NOTE:** The temperature at the end of a high-intensity fiberoptic cord is well above the ignition temperature of most surgical drapes and gowns.

2. **Electrosurgical/cautery equipment**

   ✔ **NOTE:** The temperature at the tip of the electrode is several hundred degrees, enough for cauterizing tissue, but when the tip is unprotected and the switch is activated, such equipment can ignite drapes, gowns, hair, endotracheal tubes, or anything else the tip contacts.

3. **Lasers**

   ✔ **NOTE:** Accidental activation of the laser beam has resulted in several airway fires from the ignition of the endotracheal tube. Drapes have also been ignited.

**OBJECTIVE 38** **Match types of burns to their descriptions.**

1. **Thermal—Contact with fire, hot objects, or hot fluids**

   Examples: Saline, warming blankets, lasers

2. **Electrical—Resulting from overexposure to electricity**

   Example: Electrosurgical unit

3. **Chemical—Contact with corrosive or irritating chemicals such as acids or alkalines**

   Examples: Ethylene oxide gas, Cidex®, iodine

4. **Radiation—Overexposure to radiant energy**

   Examples: Radium, X-rays, nuclear explosions, sunlight

**OBJECTIVE 39** **Discuss possible health-care related causes of patient thermal burns.**

1. **Malfunctioning, heat-generating devices in contact with patient**

   Examples: Hypo/hyperthermia machine, radio frequency diathermy unit, lasers

2. **Pooling of prep solution under the patient when using electrocautery**
3. **Using alcohol sponges when using electrocautery**
4. **Using phenol as a marking agent or a prep solution**
5. **Using hyperthermia unit with mattress above 140°F**
6. **Physical fire**

**OBJECTIVE 40** Select true statements concerning static electricity.

1. Static electricity is a common hazard in the operating room.
2. Static electricity does not cause the patient shock or burns.
3. Static electricity produces a spark which can ignite materials in the oxygen rich atmosphere of the operating room.
4. Static electricity develops from friction and accumulates on physical objects.
5. When two static-bearing objects come in contact, the one bearing the higher potential discharges to the one with the lower potential.
6. An electrostatic charge or spark between two objects can occur only when there is no pathway of conductivity between them; therefore the chief aim is dissipating the static accumulation.
7. A good conductive floor prevents accumulation of static electricity by providing a pathway of conductivity between all persons an equipment coming into contact with it.
8. Safe furniture is made of electrically conductive materials or contact to the floor is made through electrically conductive leg tips, casters, or wheels.
9. Electrically conductive materials must be kept clean and free of debris such as dirt, dust, wax, blood, glass, or suture in order to retain their full conductivity.
10. Oils, waxes, and detergents reduce the conductivity of floors and should not be used in the operating room.
11. Operating room floors are cleaned with materials that do not reduce conductivity, such as iodophor or phenolic detergents/disinfectants.

**OBJECTIVE 41** Complete statements concerning grounding operating room electrical equipment.

1. All electrical equipment, including heart monitors, defibrillators, X-ray machines, electrosurgical units, and electrical saws and drills, must be grounded to prevent the leakage of stray current.
2. When an instrument or piece of equipment is properly grounded, leakage current returns to the earth, via the ground, causing no damage.
3. If the ground path is interrupted by broken or frayed cords, plugs, or defective equipment, leakage current will seek another path to ground, and this alternate path may be through operating room personnel.

**OBJECTIVE 42** Discuss safeguards for preventing electrical and fire hazards in the operating room.

1. **Personnel safeguards**
   - Wear proper operating room attire and conductive shoe covers.
   - Cover all hair to prevent electrostatic sparks.
   - Never use open flames in the operating room.

- Never move a patient from one area to another while a flammable anesthetic is being administered.
- Properly ground a patient before using an electrosurgical unit.
- Always check electrical cords and wires for fraying and breakage before using.
- Never use a piece of electrical equipment without having been taught the proper procedure for using it.
- If equipment appears damaged or malfunctioning, immediately discontinue its use, red tag it, and send it for repair.
- Avoid unnecessary motion around the patient's head and the anesthesia machine.

  ✔ **NOTE:** The most explosive area in the operating room is the area in the 2-foot radius around the patient's face mask.

- Turn off all electrical equipment as soon as it is no longer needed.

2. **Environmental safeguards**

- Use air conditioning with controlled humidity in all operating rooms to reduce explosion hazards, provide comfort for the patient and personnel, and help control airborne bacteria.
- Keep the operating room temperature range between 60°F–80°F with the average about 70°F.
- Keep the operating room humidity between 55%–60% to minimize static electricity build-up in the presence of flammable anesthetic agents.

  ✔ **NOTE:** The minimum relative humidity should be no more than 50%.

- Ensure that air-conditioning units function properly and that air intakes and exhausts have been installed in the proper places to provide proper ventilation and filtration.

  ✔ **NOTE:** The farther apart the better to aid in preventing pockets of gas in the room.

- Ensure that **positive static pressure** is used in the operating room.

  ✔ **NOTE:** **Laminar air flow** reduces the number of organisms to 0–1 per cubic foot and provides the almost microbial-free air environment so necessary in high-risk procedures.

- Keep the operating room doors closed in order to maintain a positive static pressure.
- Make sure that the operating room furniture is made of metal or conductive rubber.
- Use only cotton blankets or sheets in the operating room because wool, silk, nylon, and synthetic materials have high static potential.

- Ensure that all electrical receptacles (outlets and switches) are at least 5 feet above floor or explosion-proof.
- Keep anesthesia machines, cylinders of compressed gas, and flammable liquid containers away from heat and do not allow them to touch each other.
- Anchor compressed gas cylinders with a chain or place in a secure rack to prevent mishaps.

KEY TERMS

**Positive static pressure**—Air pressure in the operating room is greater than the air pressure outside, thus providing a one-way laminar air flow for the prevention of the intake of outside airborne microorganisms and the accumulation of static electricity

**Laminar air flow**—Regular, continuous, nonturbulent movement of air in specific direction

OBJECTIVE 43

**Match laser classes to their characteristics.**

1. **Class I**

   Examples: Laser printers, CD players, CD-ROM devices, geological survey equipment, and laboratory analytical equipment

   - Includes all lasers that, under normal working conditions, cannot emit radiation that can cause damage
   - Are called *Eye Safe Lasers* because no individual, regardless of exposure conditions to the eyes or skin, would be expected to be injured by a Class I laser
   - Cannot emit radiation in excess of the maximum permissible exposure (MPE) limits
   - Allowable maximum power of helium-neon laser in Class I is 0.4 microwatt
   - Require no safety precautions to use Class I laser devices

2. **Class II**

   Examples: Laser pointers, aiming devices, range finding equipment

   - Includes all low-power visible light lasers that trigger the reflex of eye protection by the iris (0.25 seconds)
   - Can possibly cause damage to a person's eyes if Class II laser beams are directly viewed for long periods of time (more than 15 minutes)
   - Allowable maximum power of continuous visible laser in Class II is 1 milliwatt

3. **Class IIIa**

   Examples: Laser pointers, laser scanners such as those used to scan bar codes

- Includes continuous wave, intermediate power (1–5 mW) devices
- Includes all visible lasers (wavelength spectrum 0.4–0.7), that emit radiation at a level that does not harm a person who has a normal iris reflex
- Can cause eye damage if viewed directly or if optical instruments (such as binoculars or telescope) are used to view the radiation
- Maximum permitted power is 5 milliwatts for helium-neon and diode lasers in the visible wavelength

4. **Class IIIb**

Examples: Lasers used in spectrometry, stereolithography, and entertainment light shows

- Includes all intermediate power (c.w. 5–500 mW or pulsed 10 J/cm$^2$) devices
- Include all lasers not classified as Class I or Class II, which emit in any wavelength that can cause damage to the eye of an observer without any optical accessories
- Can cause eye damage by direct viewing and diffuse reflections
- Maximum permitted power of lasers in Class IIIb is 0.5 watt

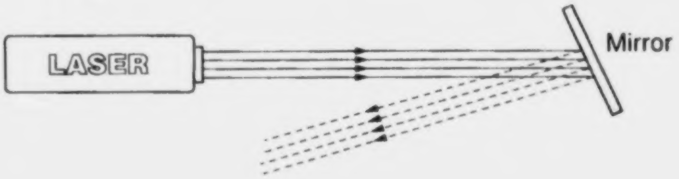
5. **Class IV**

Examples: Any lasers used in surgery, as well as those used in research, drilling, cutting, welding, and micro-machining.

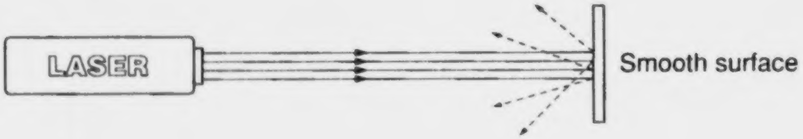
- Are high power (c.w. > 500 mW or pulsed > 10 J/cm$^2$) devices
- Includes all lasers not classified as classes I, II, and III
- Are considered as high-power lasers
- Radiation from these lasers can cause:
  - Damage to the eye even by diffusive reflectance
  - Damage to the skin
  - Fire
- Includes any laser with power output of more than 0.5 watt

**OBJECTIVE 44** **Distinguish between specular and diffuse laser beam reflections.**

1. **Specular (ordered) reflectance**—Light is reflected in one direction as from a mirror or other shiny surface.

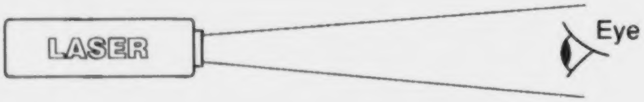


2. **Diffusive (scattered) reflectance**—Light is scattered in all directions.

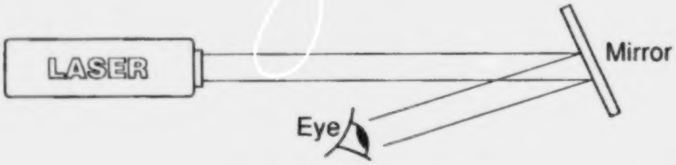


**OBJECTIVE 45** **Match laser viewing hazards to their descriptions.**

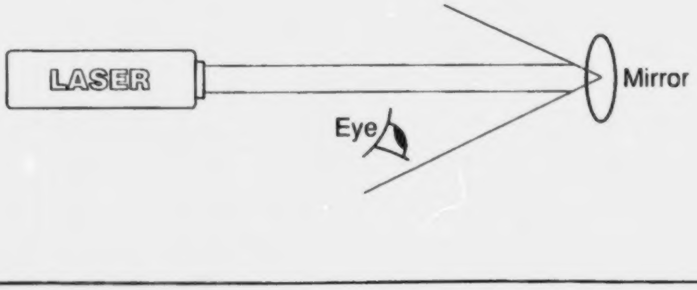
1. **Intrabeam viewing of direct (primary) beam**—Is the most hazardous type of viewing



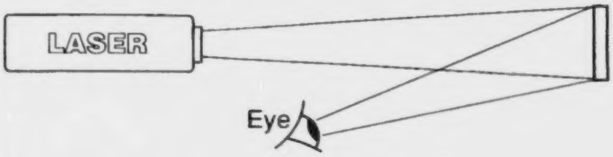
2. **Intrabeam viewing of a specularly reflected (secondary) beam from a flat surface reflector**—Is the most hazardous when the reflective surface is flat



3. **Intrabeam viewing of a specularly reflected (secondary) beam from a curved surface reflector**—Is less hazardous than a flat source reflection



4. **Extended source viewing of a normally diffuse reflection**—Is not normally hazardous, except with very high power lasers



**OBJECTIVE 46**

**Complete statements concerning laser beam hazards to the eyes and skin.**

1. **Thermal burn to eye**
   - The most likely effect of intercepting a laser beam with the eye is a thermal burn which destroys the retinal tissue.
   - Since retinal tissue does not regenerate, the damage is permanent.
2. **Thermal-acoustic damage to eye**
   - Laser pulses of a duration less than 10 microseconds induce a shock wave in the retinal tissue which causes tissue rupture.
   - Thermal-acoustic damage is more destructive than a thermal burn because it usually affects a greater area of the retina, and the threshold energy for this effect is substantially lower.
   - This damage is permanent, as with a retinal burn.
3. **Photochemical damage**—Occurs when the laser radiation wavelength is suited to excite reaction between organic molecules

   ⚠ **CAUTION:** In the last few years, some evidence was discovered of irreversible changes in biological tissue after prolonged exposure to low level laser radiation at wavelengths that were considered to have no effects at all.
4. **Other hazards**
   - When UV or IR laser light enters the eye, much of the light is absorbed in the lens; depending on the level of exposure, this may cause immediate thermal burns or the development of cataracts over a period of years.
   - The cornea and the conjunctiva tissue surrounding the eye can also be damaged by exposure to laser light.
   - Damage to the cornea and conjunctiva tissue usually occurs at greater power levels than damage to the retina; therefore, these issues become a concern only for those wavelengths that do not penetrate to the retina (i.e., UV and IR radiation).
   - Since amplification by the lens is not involved, the injuries can also be caused by diffuse and noncoherent light.

5. **Skin hazards**

   - Skin can suffer thermal burns and photochemical changes from laser exposure.
   - These effects are almost entirely independent of the coherent nature of the laser light, but are aggravated by the high power density of lasers.

OBJECTIVE 47 **Discuss precautions for safely using lasers.**

1. **Patient safety precautions**

   - Use noncombustible anesthetic agents.
   - Properly protect endotracheal tubes by insulating or wrapping with reflective aluminum or copper tape.
   - Protect the patient's eyes.
   - Use nonflammable antiseptic for skin preparation.
   - Protect skin surrounding an incision and/or target tissue from possible thermal burn.
   - Include in the postoperative instructions to the patient the care of a healing thermal wound on the skin.

2. **Personal safety precautions**

   - Wear proper eye protection.
   - Do not wear rings, watches, or other metallic apparel.

     ✔ **NOTE:** Even a gold wedding band can reflect the laser beam into the eye.

   - Protect your skin.
   - Avoid inhaling the **laser plume**.

KEY TERM

**Laser plume**—Vapor puff that occurs when the laser vaporizes tissue

3. **Environmental safety precautions**

   - Post warning signs on all doors.
   - Ensure that walls and ceilings have nonreflective surfaces.
   - Ensure that warning labels indicate points of danger to avoid exposure to laser radiation.

- Check machine for proper functioning; red tag, remove from service, and send for repair if damaged or malfunctioning.
- Place the machine on "standby" setting when not in use during the surgical procedure.
- Monitor the laser foot switch.
- Use nonreflective instruments.
- Keep on hand a basin of sterile water in case of fire.
- Ensure that all electrical codes are followed and enforced.
- Follow the manufacturer's instructions and cautions for operation, care, handling, and sterilization procedures.

**OBJECTIVE 48**

# Job Sheet 1—Maneuver a Wheelchair Safely

Name ____________________ Attempt number ____________

Date ____________________ Overall rating ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Set the wheelchair brake before assisting "patient" into and out of wheelchair and before leaving wheelchair to activate the elevator DOOR HOLD button | ______ |
| • Performed all steps in the procedure smoothly and in proper sequence | ______ |
| • Returned wheelchair to proper location | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________

________________________________________

________________________________________

**INTRODUCTION**

Maneuvering wheelchairs safely is not as easy as it at first may appear. It is easy to adjust the patient's footrests on a wheelchair to an angle uncomfortable for the patient and even to trap the patient's feet on the wrong side of the footrests. This job sheet will provide you with the practice you will need to maneuver a wheelchair safely.

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- IV hook and cart (optional)
- Wheelchair
- Elevator

**PROCEDURE**

☐ 1. Position the wheelchair next to the patient.

✔ **NOTE:** For the purpose of this exercise, we will assume that the patient is semi-ambulatory and can place himself or herself in the wheelchair.

☐ 2. Set the wheelchair brake.

☐ 3. Swing the wheelchair footrests out of the way.

☐ 4. Assist the patient in sitting in the wheelchair.

☐ 5. Adjust the footrests for patient comfort.

☐ 6. Release the wheelchair brake.

☐ 7. Check to ensure that neither the patient nor the patient's garments are touching the floor or wheelchair wheels.

☐ 8. Push the wheelchair smoothly and slowly to the elevator, taking care to avoid rough surfaces and not to bump the patient's legs.

☐ 9. Keep to the right side of the hallway and check the overhead mirrors before turning a corner.

☐ 10. Upon reaching the elevator, pull the wheelchair to the side of the elevator doors and out of the way of exiting passengers.

☐ 11. Set the wheelchair brake.

☐ 12. Ring for the elevator.

☐ 13. After the elevator arrives and is empty of passengers, reach in and press the DOOR HOLD button, temporarily locking the doors open.

☐ 14. Release the wheelchair brake, swivel the wheelchair, and back into the elevator, pulling the wheelchair in after yourself.

☐ 15. Deactivate the DOOR HOLD button.

☐ 16. Press the button for the desired floor.

☐ 17. On reaching the desired floor, press the HOLD button after any other passengers have exited the elevator.

☐ 18. Push the wheelchair slowly over the elevator sill and out of the elevator, parking it out of the way to the side of the elevator with the brake engaged.

☐ 19. Deactivate the DOOR HOLD button.

☐ 20. Push the wheelchair next to a chair, and facing in the same direction.

☐ 21. Set the wheelchair parking brake.

☐ 22. One at a time, and while telling the patient what you are doing, swing back the footrests and allow the patient's feet to touch the floor.

☐ 23. Assist the patient from the wheelchair to the chair.

☐ 24. Release the brake and return empty wheelchair to proper location.

Evaluator's Comments: ______________________________

______________________________

______________________________

**OBJECTIVE 49**

## Job Sheet 2—Maneuver a Stretcher Safely

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Set the stretcher brake before assisting "patient" onto and down from the stretcher and before leaving wheelchair to activate the elevator DOOR HOLD button | _____ |
| • Performed all steps in the procedure smoothly and in proper sequence | _____ |
| • Returned stretcher to proper location | _____ |
| **Overall rating** | _____ |

Evaluator's comments ______________________________________________

**INTRODUCTION**

Maneuvering stretchers safely is not as easy as it first may appear. Stretchers are long and unwieldy, some seemingly having a mind of their own. It takes practice to be able to wheel a stretcher smoothly and in the desired direction. This job sheet will provide you with the practice you will need to maneuver a stretcher safely.

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- IV hook and cart (optional)
- Stretcher
- Elevator

**PROCEDURE**

☐ 1. Lock the stretcher wheels and allow the student who is playing the patient to climb onto the stretcher.

☐ 2. Have the "patient" lie down, head toward you.

☐ 3. Cover the patient with a blanket.

☐ 4. Raise the sides of the stretcher and lock in place.

☐ 5. Attach the IV bag if necessary, or have a third student wheel the IV cart beside the stretcher as you move.

☐ 6. Release the stretcher brake and push the stretcher toward the elevators.

☐ 7. Keep to the right side of the hallway and check the overhead mirrors before turning a corner.

☐ 8. Turn corners wide but continue to stay to the right side of the hallway.

☐ 9. Practice turning corners several times as necessary.

☐ 10. Upon reaching the elevator, push the stretcher to the side of the elevator doors and out of the way of any exiting passengers.

☐ 11. Set the stretcher brake.

☐ 12. Ring for the elevator.

☐ 13. After the elevator arrives and is empty of passengers, reach in and press the DOOR HOLD button, temporarily locking the doors open.

☐ 14. Release the stretcher brake and pull the stretcher smoothly onto the elevator, taking care not to bump the patient's feet.

☐ 15. Deactivate the DOOR HOLD button.

☐ 16. Press the button for the desired floor.

☐ 17. On reaching the desired floor, press the DOOR HOLD button after any other passengers have exited the elevator.

☐ 18. Push the stretcher slowly over the elevator sill and out of the elevator, parking it out of the way to the side of the elevator with the brake engaged.

☐ 19. Deactivate the DOOR HOLD button.

☐ 20. Assist the "patient" in getting off the stretcher and onto his or her feet.

☐ 21. Return empty stretcher to proper location.

Evaluator's Comments: ____________________________________________

______________________________________________________________

______________________________________________________________

**OBJECTIVE 50**

# Job Sheet 3—Demonstrate Effective Hand Washing Procedure

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

| Evaluation criteria | Rating |
|---|---|
| • Did not touch the sink when turning on the water | ______ |
| • Lathered well up the arm and washed both hands in a brisk rotary motion, holding forearms lower than elbows | ______ |
| • Left water running through entire procedure | ______ |
| • Dried hands and forearms thoroughly with paper towels | ______ |
| • Used a paper towel to turn off faucet if it was hand operated | ______ |
| • Applied hand lotion as permitted | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

______________________________________________

______________________________________________

---

**INTRODUCTION**

The most important method of preventing the transfer of disease-causing microorganisms is correct and frequent hand washing. Proper hand washing protects the patient, your co-workers, you, and your family.

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Deep sink, preferably with foot, elbow, or knee actuated faucets
- Liquid or powdered soap, preferably in a dispenser
- Nail file or orangewood stick
- Paper towels
- Hand lotion (optional)

**PROCEDURE**

☐ 1. Roll your sleeves above your elbows and remove all jewelry and watch—or slide watch up above elbow.

☐ 2. Do not touch the outside or inside of the sink.

☐ 3. Turn on the water and adjust the temperature to warm.

☐ 4. Dispense liquid or powdered soap, preferably with a foot, elbow, or leg control.

☐ 5. Lather your hands and up your arms well.

☐ 6. Clean your fingernails as needed with a nail file or orangewood stick.

☐ 7. Keeping your hands lower than elbows at all times, wash your hands and arms up to your elbows, adding soap as needed to maintain lather and washing for at least 30 seconds.

✔ **NOTE:** Microorganisms are suspended in the lather and later washed off.

  ☐ a. Rub briskly using friction and a rotary motion (as opposed to back-and-forth motion).

  ☐ b. Pay particular attention to the areas between your fingers, your knuckles, and the outside surfaces of your "little fingers" as these surfaces are often missed.

  ☐ c. Leave the water running during the entire procedure.

☐ 8. Holding your hands and forearms lower than your elbows, rinse thoroughly, starting at one elbow and moving down the arm. Repeat this step for the other arm.

☐ 9. Dry your hands thoroughly from fingers to forearms, using the paper towels provided and blotting rather than rubbing.

☐ 10. Use a dry paper towel to turn off the faucet if it was hand operated.

☐ 11. Use lotion as needed and as your facility permits.

✔ **NOTE:** In some facilities, you may be asked not to use lotion during the workday because it can be an excellent medium for bacterial growth in the healthcare environment.

Evaluator's Comments: ______________________________

______________________________

______________________________

# Introduction to Surgical Technology

## SECTION C: Microbiology

### Module 1-C: Introduction to Microbiology

## Module Contents

**COMPONENTS**

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Assignment Sheet

1—Research the Causes of and Prevention of a Human Disease . . . . . . . . . . 29

# Introduction to Surgical Technology
## Section C: Microbiology
## Module 1-C: Introduction to Microbiology

**PREREQUISITES:** None

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 12.

☐ 5. **Research** Online resources to learn more about microbiology. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Study** Information Sheet, Objective 13 through Objective 22.

☐ 7. **Do** Assignment Sheet 1, "Research the Causes and Prevention of a Human Disease."

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, repeat step 7.

☐ 9. **Take** Written Test provided by your instructor.

☐ 10. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 11. If the evaluation is not satisfactory, repeat steps 4 and 6.

☐ 11. **Check** With your instructor for any additional assignments to be completed.

☐ 12. **Do** Additional assignments your instructor lists below.

______________________________

______________________________

______________________________

☐ 13. **Take** Module Review provided by your instructor.

☐ 14. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 15. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions

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## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to distinguish between microorganisms and their diseases. You should demonstrate these competencies by completing the assignment sheet and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Arrange in order the levels of the taxonomy system for classifying organisms.
2. Select major classes of microorganisms.
3. Describe the classes of microorganisms.
4. Match the types of microbial relationships to their correct descriptions.
5. Distinguish among normal flora, resident flora, and transient flora.
6. Describe the purpose of a gram stain.
7. Select true statements concerning characteristics of bacteria.
8. Label types of bacteria according to their shape.
9. Match specialized structures of bacteria to their correct descriptions.
10. Distinguish between types of toxins produced by bacteria.
11. Select true statements concerning growth requirements of bacteria.
12. Match pathogenic bacteria to the correct diseases they cause.
13. Distinguish between characteristics of fungi and algae.
14. Distinguish between characteristics of yeasts and molds.
15. Select true statements concerning characteristics of protozoa.
16. Match protozoan diseases to their correct causes and characteristics.
17. Complete statements concerning the characteristics of rickettsiae.
18. List diseases caused by rickettsiae.
19. Select true statements concerning characteristics of helminths.
20. List common parasites that afflict humans.
21. Complete statements concerning characteristics of viruses.

22. List viral diseases according to type.
23. Research the causes and prevention of a human disease. (Assignment Sheet 1)

## Information Sheet

OBJECTIVE 1 **Arrange in order the levels of the taxonomy system for classifying organisms.**

✔ **NOTE:** Scientists use a system called *taxonomy* to classify all organisms based on their similarities and differences. The system contains seven major levels, beginning with the very broadest similarities and getting more specific until a single kind of organism is identified.

1. **Kingdom**

   ✔ **NOTE:** There are two major kingdoms: plants and animals. As advances in technologies have enabled scientists to discover more about **microbiology** and biochemistry, other kingdoms have been added, including fungi, protists (including most algae), and monera (including bacteria). Humans are classed in the animal kingdom.

2. **Phylum**

   Example: The human phylum is *Chordata*.

3. **Class**

   Example: The human class is *Mammalia*.

4. **Order**

   Example: The human order is *Omnivora*.

5. **Family**

   Example: The human family is *Primates*.

6. **Genus**

   Example: The human genus is *Homo*.

7. **Species**

   Example: The human species is *Sapiens*.

KEY TERMS

**Microbiology**—Study of **microorganisms**

**Microorganism**—Minute living body not perceptible to the naked eye

**OBJECTIVE 2** **Select major classes of microorganisms.**

1. **Bacteria**
2. **Fungi and algae**
3. **Protozoa**
4. **Rickettsiae**
5. **Viruses**

**OBJECTIVE 3** **Describe the classes of microorganisms.**

1. **Bacterium**—A widely distributed **unicellular** organism that may or may not cause disease

   ✔ **NOTE:** The plural of bacterium is *bacteria*. There are three primary ways of classifying bacteria. They are classified by their shape, by their arrangements, and by whether they require oxygen (**aerobic**) or not (**anaerobic**). The study of bacteria is called *bacteriology*.

2. **Fungus**—A unicellular or multicellular organism that reproduces by means of spores and that may be pathogenic or nonpathogenic

   ✔ **NOTE:** The plural of fungus is *fungi*. Many fungi, such as molds and mushrooms, live on dead matter and help to decompose it. Unicellular fungi are called *yeast*, and many of them are pathogenic to humans, causing yeast infections in moist areas of the body, athlete's foot, ringworm, and other conditions. In some cases, persons with weakened immune systems may experience serious illness and even death from inhaling spores that infect the pulmonary regions. A yeast-induced illness is called a **mycosis**. *Mycology* is the study of fungi.

3. **Protozoan**—A unicellular organism that is adapted for life in water and forms cysts that pass from **host** to host

   ✔ **NOTE:** The plural of protozoan is *protozoa*. Many protozoa are pathogenic to humans. Some, such as those that cause amebic dysentery and giardiasis, are contracted by consuming infected food or water. Others, such as those that cause malaria, are spread by other organisms, such as mosquitoes.

4. **Worm**—A multicellular organism that in its parasitic form can be pathogenic to humans

   ✔ **NOTE:** Generally referred to as *helminths* in the medical profession, parasitic worms can produce very serious infestations because they live inside the body and feed on the host's blood and nutrients. Many go through several life stages only some of which are parasitic or that require different hosts for each stage. Flukes, tapeworms, pinworms, and hookworms are examples of helminths that infect humans.

5. **Virus**—A subcellular organism that reproduces as a **parasite** within other organisms and, consequently, is pathogenic

   ✔ **NOTE:** Viruses are smaller than bacteria. They consist of DNA or RNA within a protein shell; the protein shell of each virus has a distinct shape. During reproduction, the virus enters a cell in the host and uses the chromosomes and enzymes in the cell to replicate itself. The cell will then die. The severity of the disease depends on the kind of cell that is infected. Rabies, chicken pox, measles, influenza, cold sores, polio, and certain tumors are all the result of viruses. *Virology* is the study of viruses.

KEY TERMS

**Unicellular**—Consisting of one cell

**Aerobe**—Microorganism that requires oxygen to live

**Anaerobe**—Microorganism that lives without oxygen

**Host**—The organism that provides the resources required to sustain a parasitic relationship

**Mycosis**—Any disease induced by a fungus

**Parasite**—Organism that lives within, upon, or at the expense of another living organism known as the host

OBJECTIVE 4

**Match the types of microbial relationships between organisms to their correct descriptions.**

✔ **NOTE:** Because we share the planet with each other, organisms form relationships with each other. Generally, these relationships may be classed as beneficial, harmful, or neutral. For example, you know that certain organisms can cause illness in humans. On the other hand, there are organisms that live in our intestines that help us to digest food. Still other organisms seem to have little or no interaction with humans. The terms presented in this objective describe some of the more-important relationships that can exist between organisms.

1. **Symbiosis**—A relationship between two organisms that have close contact with each other

   ✔ **NOTE:** Symbiosis is a general term for any close relationship between organisms of different species, whether that relationship is beneficial or harmful or neither. The two organisms may simply live very near each other, the two organisms may have physical contact, or one organism may actually live on or within the other.

2. **Mutualism**—A relationship between two organisms that is beneficial to both

   ✔ **NOTE:** In a mutualistic relationship, the organisms maintain close contact with one another and both benefit from each other. For example, tick birds stay near herds of cattle or antelope. The birds feed on insects and other pests that bother the herd animals. Thus, both type of organisms benefit. The term *symbiosis* was once applied to this type of relationship but now has a broader meaning.

3. **Commensalism**—A relationship between two organisms in which one organism benefits and the other neither benefits nor is harmed

   ✔ **NOTE:** The remora fish that attach themselves to sharks, whales, and sea turtles provide no benefit to their hosts yet cause their hosts no real harm. However, the remora is able to eat bits of food that the host misses when feeding. In this way the remora benefits from the commensalistic relationship.

4. **Neutralism or independence**—A relationship between two organisms in which the organisms present no significant benefit or harm to each other

   ✔ **NOTE:** Squirrels and songbirds that live in the same tree share a neutralistic relationship. While there may be some competition for food and nest sites, the two species have little interaction. In parts of Africa, herds of animals, like zebras and wildebeests, travel and graze together. The increased herd size may allow a greater degree of alertness to danger from predators, but there is essentially no direct benefit to either type of organism.

5. **Parasitism**—A relationship between two organisms in which one organism is harmed by the presence of the other

   ✔ **NOTE:** Parasitism is an important concern to all health professionals. The organisms that cause diseases in humans are generally parasites. Additionally, disease-carrying organisms such as fleas and ticks are parasitic on humans.

6. **Pathogenic**—A relationship between two organisms in which one organism is capable of causing a disease in the other organism

   ✔ **NOTE:** There are organisms that live inside humans in mutualistic relationships. They are nonpathogenic. However, other organisms that enter the body can cause a variety of diseases, generally through the production of toxins that disrupt normal cell functioning. An opportunistic microorganism causes infection when given the opportunity by the altered physiological state of the host.

7. **Antibiosis**—One organism produces substances or causes conditions which are lethal for other organisms

OBJECTIVE 5 **Distinguish among normal flora, resident flora, and transient flora.**

✔ **NOTE:** While some organisms are pathogenic to humans, many live in the body or on its surface in mutualistic or commensalistic relationships. These organisms are referred to as *resident flora*. Those organisms that inhabit the body temporarily are referred to as *transient flora*. In some cases, a resident flora will become pathogenic. Typically, this happens when the population of some other resident flora has declined, allowing the organism that becomes pathogenic to multiply well beyond its normal number. An organism that takes advantage of a temporary situation to spread is called an *opportunist*.

1. **Resident flora**—Organisms that normally live in and on the bodies of healthy persons without causing harm when located in specific sites

2. **Transient flora**—Organisms that take up residence in or on the body temporarily in a location where they are not normally found

3. **Normal flora**—Microscopic plant life such as bacteria which are adapted to residing in a given area of the body during health

   Examples: Skin flora, intestinal flora, vaginal flora

   ✔ **NOTE:** Normal flora live in a state of relative balance. Any condition such as excessive antibiotic intake that upsets this balance can cause an overgrowth of other organisms in the area with resulting symptoms of disease.

OBJECTIVE 6 **Describe the purpose of a *gram stain.***

1. **Identifies the shape of a *pathogen***
2. **Indicates a positive or negative characteristic allowing preliminary identification of the organism**

   ✔ **NOTE:** The identification and treatment of a disease often depends on interpreting a limited number of clues, such as a person's symptoms. Another clue is the identification of the pathogenic organism involved. One method of identifying bacteria is the gram stain, in which an infected sample or **culture**, such as saliva, is treated with a dye and examined under a microscope. The shape and color of the organism is apparent under the microscope. If the bacteria turn a bluish color, the bacteria can be classed as gram-positive bacteria. If the bacteria turn a reddish color, the bacteria can be classed as gram-negative bacteria. Since a genus will react as either positive or negative and a shape may be particular to a genus or species, the gram-stain test is often enough to specifically identify an organism.

| | |
|---|---|
| Examples of gram-positive bacteria: | *Streptococcus, Staphylococcus, Clostridium* |
| Examples of gram-negative bacteria: | *Pseudomonas, Proteus, Salmonella, Hemophilus* |

KEY TERMS

**Gram stain**—Laboratory technique to identify bacteria which consists of staining bacteria with a violet stain and then counterstaining with a red stain

**Pathogen**—Disease-causing microorganism

**Culture**—Tissue sample, washing or swabbing that is grown in a media under either aerobic or anaerobic conditions

OBJECTIVE 7 **Select true statements concerning the characteristics of bacteria.**

1. **Are unicellular**
2. **Are simple plant organisms**
3. **Ordinarily do not contain chlorophyll**
4. **Have approximately 2000 known species and are found everywhere**
5. **Only about 100 species produce disease in human beings**

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6. **Are classified in two ways:**

   - Pathogenic—Produces toxins which cause many diseases such as syphilis, gonorrhea, tuberculosis, typhoid and paratyphoid fevers, and whooping cough
   - Nonpathogenic—Essential for life, assist in decomposition of matter, and aid in production of some foods and chemicals such as cheeses, sauerkraut, cultured milk products, and lactic acid

7. **The tough outer cell wall gives a bacterium its shape.**

8. **Cocci and bacilli often colonize with each other so that another way of identifying bacteria is by the shape of their colonies.**

   ✔ **NOTE:** The shape of the bacterial groups is added as a prefix to the shape of the organism. Thus, cocci that forms clusters are called *staphylococcus*, those that form chains are called *streptococcus*, and those that form pairs are called *diplococcus*. There are also strepto- and diplo- forms of bacilli.

9. **Bacteria reproduce by *binary fission*, in which the chromosome duplicates itself and then the cell divides into two identical cells.**

10. **Aerobic species require that oxygen be present in order to reproduce.**

11. **Anaerobic species require that no oxygen be present in order to reproduce.**

12. ***Facultative* anaerobic species can reproduce with or without oxygen.**

    ✔ **NOTE:** A facultative anaerobe prefers to live without oxygen, but can live with oxygen.

KEY TERMS

**Binary fission**—Method of asexual reproduction in which the cell divides into two parts

**Facultative**—Having the capability to live under certain environmental circumstances and having the ability to adapt to more than one condition

OBJECTIVE 8

**Label types of bacteria according to their shapes (*morphology*).**

1. **Sphere or round forms—Coccus (plural—cocci)**

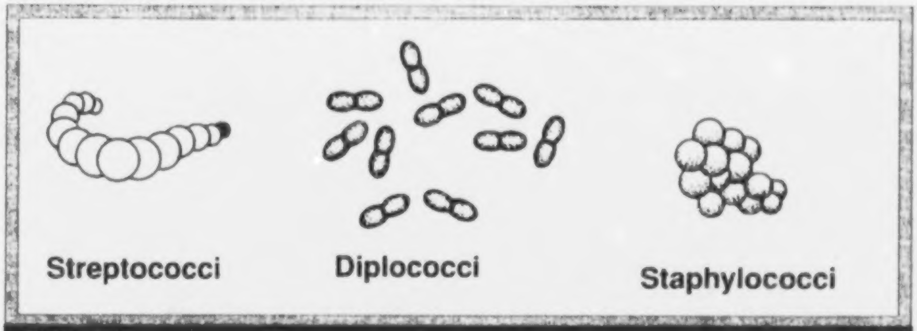
Streptococci
Diplococci
Staphylococci

**Figure 1**
Cocci

- Diplococci—Appear in pairs
- Streptococci—Cling together in long chains
- Staphylococci—Arrange themselves in grapelike clusters

2. **Rod or cylinder shapes**—Bacillus (plural—bacilli)

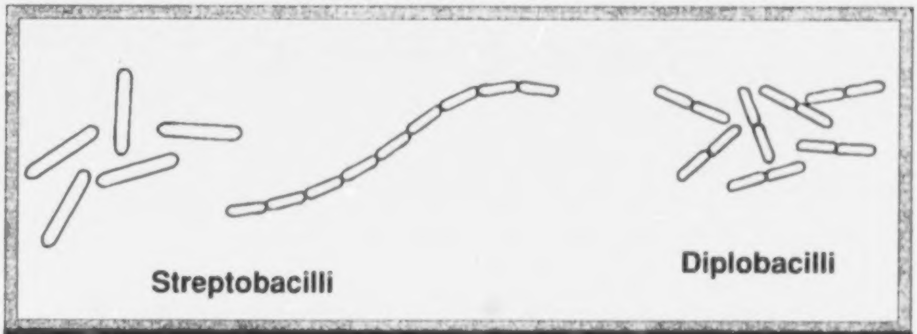
Streptobacilli
Diplobacilli

**Figure 2**
Bacilli

✔ **NOTE:** Some bacilli are long and slender, others short and plump and may be mistaken for cocci.

- Diplobacilli—Appear in pairs
- Streptobacilli—Appear in chains

3. **Spiral or curved forms**

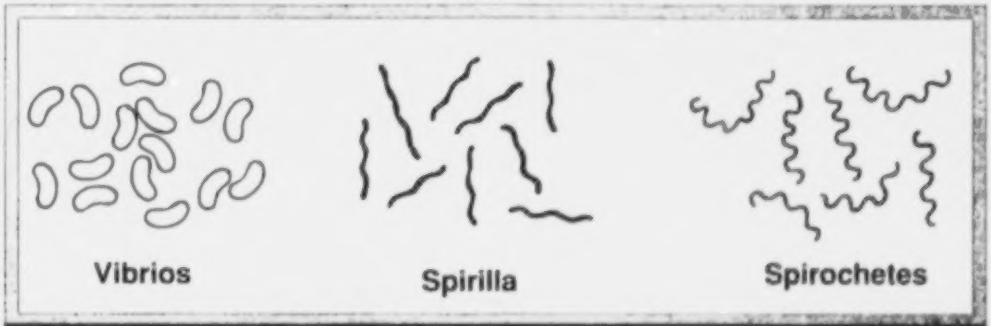

**Figure 3**
Spiral-shaped

- Vibrio—Short, slightly bent, comma-shaped rod
- Spirillum (plural—spirilla)—Longer, rigid, curved organism, usually with several spirals and several flagella
- Spirochete—Longer, flexible, and motile spiral organism

KEY TERM

**Morphology**—Science of structure and form

OBJECTIVE 9 **Match specialized structures of bacteria to their correct descriptions.**

1. **Spores**

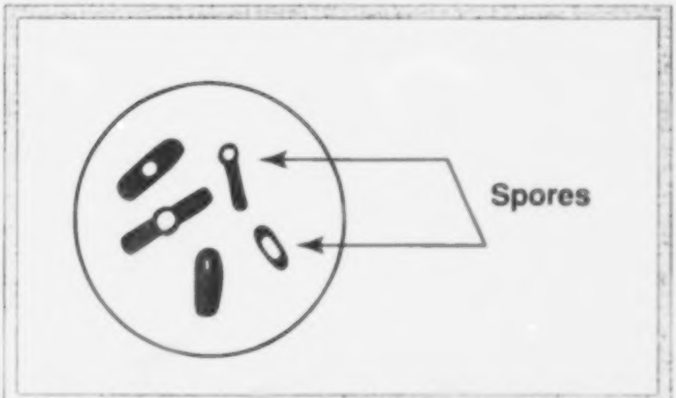

**Figure 4**
Spores

- Are round structures of condensed protoplasm that are formed within the bacteria
- Are produced by approximately 150 species of bacilli (not all species). Each bacillus forms one **spore**.
- Are inactive, dormant forms; not reproductive forms
- Are capable of developing into a new vegetative organism under the right conditions
- Resist drying, boiling, and most chemical disinfectants
- Spore-forming pathogens include several *Clostridium sp.* which cause anthrax, botulism, tetanus, and gas gangrene.
- Autoclaving will destroy spores. Sterility may be defined as the absence of all microorganisms including spores.

2. **Capsules**

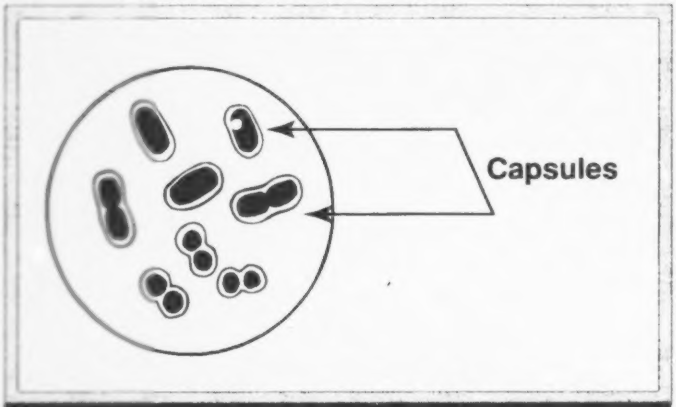

**Figure 5**
Capsules

- Are layers that surround many bacterial cells
- Increase **virulence** of bacteria
- Interfere with **phagocytosis** by white blood cells
- Aid in identification

### 3. Flagella

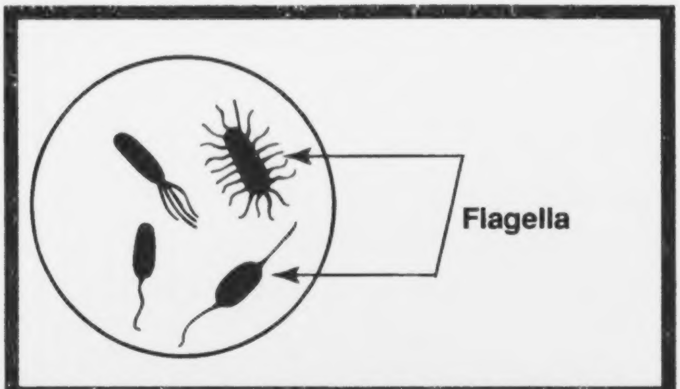

Figure 6
Flagella

- Are hair-like processes that cause the bacteria to move along in liquid by their wavelike rhythmic contractions
- Are present on bacilli and spirilla

  ✔ **NOTE:** Cocci are not motile. Spirochetes are motile by rotating in a corkscrew fashion, not by use of a flagellum.

- Presence or absence aids in identification

KEY TERMS

**Virulence**—Relative power of a pathogen to cause disease

**Phagocytosis**—Ingestion and digestion of bacteria and particles; cell eating

**Spore**—The specialized form of a bacterium or the reproductive form of a fungus that resists the usual methods of sterilization

OBJECTIVE 10

**Distinguish between types of of toxins produced by bacteria.**

### 1. Endotoxins

- Are contained in the bacterial cell walls
- Are liberated only when the bacterial cell dies and disintegrates
- When the endotoxin is liberated, it produces some of the symptoms of infectious diseases.
- Examples are organisms causing typhoid fever and bacillary dysentery.

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2. **Exotoxins**

- Are the most potent toxins known
- Diffuse out of the intact bacterial cells into the surrounding medium or tissue
- Will produce most of the characteristic symptoms and lesions of the disease
- Examples are organisms causing tetanus, gas gangrene, diphtheria, and scarlet fever.

OBJECTIVE 11

**Select true statements concerning growth requirements of bacteria.**

1. **Moisture**

- Favors growth
- Drying may kill some bacteria.

✔ **NOTE:** Drying kills bacteria such as the organisms causing gonorrhea and syphilis. Others such as tuberculosis and staphylococcus can withstand drying for long periods and again become active.

2. **Food**

- **Autotrophic** bacteria use carbon dioxide and other inorganic compounds for food and are nonpathogenic.
- **Heterotrophic** bacteria require living or dead organic matter for food and are pathogenic.
  - Parasites utilize living organic matter for food.
  - Saprophytes utilize dead organic matter for food.

  Examples: Organisms causing tetanus, gas gangrene, and botulism

3. **Oxygen or lack of oxygen**

- Aerobic bacteria must have oxygen to live.

  Example: *Staphylococcus aureus* (responsible for skin and wound infections)

- Anaerobic bacteria cannot live in the presence of oxygen.

  Example: *Clostridium sp.* (causing tetanus, gas gangrene, and botulism)

  ✔ **NOTE:** Tetanus and gas gangrene will not result from surface wounds. Both diseases result from deep puncture wounds or openings deep in tissue as occurs in surgery.

- **Microaerophilic** bacteria require oxygen less than that in the atmosphere.

  Examples: Hemolytic species of *Streptococcus* (responsible for strep throat)

4. **Moderate temperature**

- High heat destroys most bacteria.

  ✔ **NOTE:** Temperature necessary for destruction depends upon the organism involved.

- Freezing does not always destroy bacteria, but does reduce growth and metabolic activities.

- Most bacteria grow best at normal body temperature.

5. **Neutral pH**

- Most bacteria grow best close to the neutral point on the pH scale or slightly on the alkaline side.

- Both acids and alkalis are harmful to bacteria.

- Vinegar is acidic and may be used to decrease bacterial growth.

  Examples: Pickling vegetables, using a vinegar douche

  ✔ **NOTE:** Cranberry juice may be given to catheterized patients to make their urine more acidic, which will control the growth of bacteria in the area.

6. **Darkness**

- Most bacteria are killed by direct sunlight.

- Spore formation is stimulated by sunlight (because the bacterium is stressed).

KEY TERMS

**Autotrophic**—Capable of growing in absence of organic compounds; self-nourishing

**Heterotrophic**—Requiring organic compounds to live and grow

**Microaerophilic**—Microorganism that requires oxygen, but thrives best when oxygen is less than that in the atmosphere

OBJECTIVE 12 **Match pathogenic bacteria to the correct diseases they cause.**

1. **Cocci**

- Certain strains of *Staphylococci*—Cause food poisoning

- *Staphylococcus aureus*—Causes most post-operative wound infections

- *Streptococcus pyogenes*—Causes strep throat, scarlet fever, pneumonia, glomerulonephritis, and rheumatic heart disease

- *Neisseria gonorrhoeae*—Causes gonorrhea
- *Neisseria meningitis*—Causes bacterial (meningococcal) meningitis

2. **Bacilli**

- *Salmonella typhi*—Causes typhoid fever
- *Shigella dysenteriae*—Causes bacterial (bacillary) dysentery
- *Escherichia coli*—Causes gastroenteritis, urinary tract infections, pyelonephritis, and epidemic diarrhea in newborn nurseries
- *Corynebacterium diphtheriae*—Causes diphtheria
- *Bordetella pertussis*—Causes whooping cough (pertussis
- *Clostridium tetani*—Causes tetanus (lockjaw)
- *Clostridium perfringens*—Causes gas gangrene
- *Clostridium botulinum*—Causes botulism
- *Mycobacterium tuberculosis*—Causes tuberculosis
- *Pseudomonas aeruginosa*—Can cause severe wound infections, urinary tract infections, osteomyelitis, meningitis, and septicemia when resistance of host is especially low, such as in burn patients

3. **Spiral-shaped bacteria**

- Spirochete—*Treponema pallidum*—Causes syphilis
- Vibrio—*Vibrio cholerae*—Causes cholera

OBJECTIVE 13

**Distinguish between the characteristics of fungi and algae.**

✔ **NOTE:** Fungi and algae are two types of plants. They are distinct from each other primarily in that alga has chlorophyll in its cells and can produce its own nourishment in the presence of light. Fungi do not have chlorophyll and must extract their nutrition from an external source, such as decaying organic matter or a live host. Both types of organisms are simple plants and are not differentiated into complex structures such as root systems and leaves. Many types of fungi are capable of infecting humans. Infections with algae are extremely rare with fewer than 100 cases reported in humans.

1. **Fungi**

- May be unicellular or multicellular
- Some fungi are normally found in and on the body.
- Fungi infections may result from the use of antibiotics or reduced resistance due to injuries or diseases.

- Most fungi infections are superficial but can spread to the inside of the body through spores.
- Are in the plant kingdom
- Lack chlorophyll
- Contain over 100,000 species
- Include yeasts and molds
- Some fungi are a common sight on stale bread, rotten fruit, or damp leather.
- Have to exist in one of two ways:
  - Parasite—Existing on another living organism
  - Saprophyte—Living on dead matter

2. **Algae**

- May be unicellular or multicellular
- **Infestation** generally occurs as a result of a break in the skin or a trauma, including surgery, and is generally limited to the skin or bursa.
- The most-common symptom is skin lesions that resemble many other conditions so that the diagnosis must be confirmed through laboratory analysis.

KEY TERM

**Infestation**—The presence of parasites in the environment, on the skin, or in the hair of a host

OBJECTIVE 14

**Distinguish between the characteristics of yeasts and molds.**

1. **Yeasts**

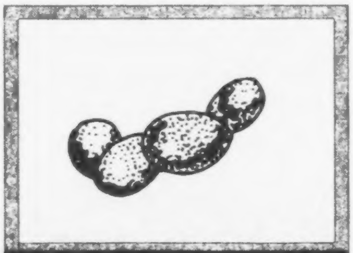

Figure 7
Yeast cells

- Are unicellular, microscopic organisms

- Reproduce by **budding**
- Some are used commercially in preparing beer, wine, and breads.
- A common yeast mycosis is *Candida* infection caused by *Candida albicans*.
  - Infects mucous membranes of the mouth and is known as thrush
  - Infects female genitalia and is known as vulvovaginitis or vaginal thrush

    ✔ **NOTE:** Thrush is seen commonly in newborns infected by the mother.

2. **Molds**

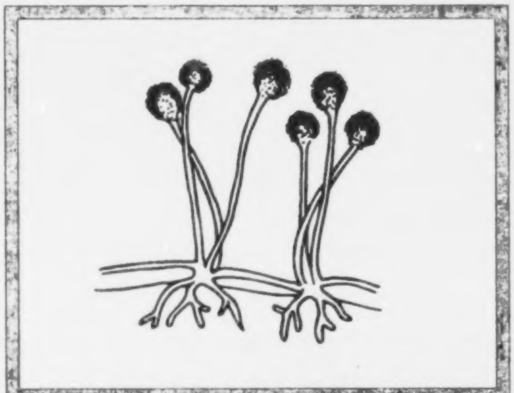

Figure 8
Molds

- Are multicellular
- Are characterized by a fuzzy growth of interlacing filaments called *hyphae*
- Reproduce by spores
- Some may be seen on foods such as bread and cheese.
- Ringworm of the scalp (*Tinea capitis*) and ringworm of the foot (*Tinea pedis*—athlete's foot) are common mycoses caused by molds.

KEY TERM

**Budding**—Method of asexual reproduction in which a budlike process grows from the side or end of the parent and develops into a new organism

OBJECTIVE 15

**Select true statements concerning the characteristics of protozoa.**

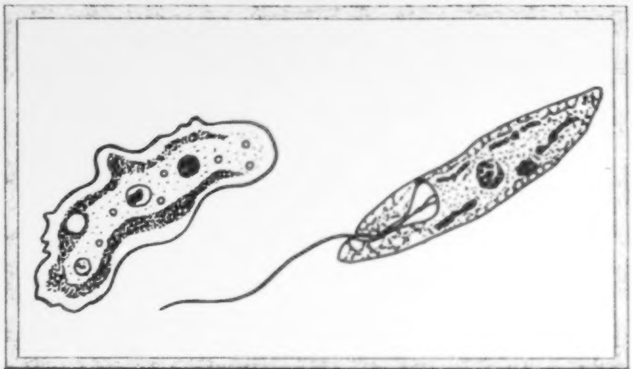

Figure 9
Protozoa

1. **Are unicellular**
2. **Are simple forms of animal life**
3. **Are microscopic**
4. **Take their food in solid particles**
5. **Are motile using pseudopods, flagella, or cilia**
6. **Reproduce sexually or asexually by fission**
7. **When subjected to adverse conditions, they become inactive.**
    - They assume a rounded form, and surround themselves with a heavy protective cell wall in a process called **cyst** formation.
    - They can live in the cyst form for a long time, and when conditions are right, return to a vegetative state.
8. **Live in water and soil**
9. **Generally spread from food or water contaminated with cysts**

KEY TERM

**Cyst**—A capsule that forms around microorganisms before they enter dormant periods

OBJECTIVE 16

**Match protozoan diseases to their correct causes and characteristics.**

1. **Amebic dysentery**
   - Caused by *Entamoeba histolytica*
   - Symptoms are intense diarrhea with bloody, mucous-filled stools
   - Occurs following fecal contamination of food or drink
2. **Malaria**
   - Caused by a parasite of the *Plasmodium* genus (several species)
   - Transmitted by the bite of a female *Anopheles* mosquito or by a contaminated hypodermic needle or blood transfusion
   - Characterized by chills and fever
3. **Giardiasis**
   - Caused by drinking water containing giardia
   - Symptoms include diarrhea
4. **Trichomonas infection**
   - Caused by *Trichomonas vaginalis*
   - Characterized in women by vaginitis with a profuse, cream-colored, foul-smelling discharge
   - Transmitted by sexual intercourse, contaminated douche equipment, contaminated examination instruments, and contaminated towels

OBJECTIVE 17

**Complete statements concerning the characteristics of rickettsiae.**

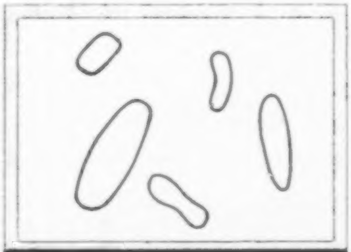

**Figure 10**
Rickettsiae

1. **Are much smaller than bacteria, but larger than viruses**
2. **Are parasites (can only grow inside living cells)**

3. **Are transmitted to human beings by arthropods (insects or animal *vectors* such as lice, mice, fleas, rats, and ticks)**

   ✔ **NOTE:** All insects, arachnids (such as spiders), and creatures such as lobsters and crabs are arthropods. Some arthropods are parasitic on humans, including ticks, lice, and mites. Many, such as bees, spiders, and scorpions, carry toxins that can be harmful to humans, especially persons with allergies to arthropod venom. Arthropods such as ticks, fleas, flies, and mosquitoes can present additional risks to humans by carrying infectious organisms that enter the bloodstream when the arthropod bites.

KEY TERM

**Vectors**—A carrier, usually an arthropod or insect that transmits the causative organisms of disease from infected to noninfected individuals

OBJECTIVE 18

**List diseases caused by rickettsiae.**

1. ***Rickettsia ricketsii* (tick-borne) causes Rocky Mountain spotted fever.**
2. ***Rickettsia typhi* causes endemic (flea-borne) typhus. *Rickettsia prowazekii* causes epidemic (louse-borne) typhus.**
3. **Rickettsiae infections can be treated with antibiotics.**

OBJECTIVE 19

**Select true statements concerning the characteristics of helminths.**

✔ **NOTE:** Helminths are included in this module on microbiology because they are microscopic in certain stages of their life cycle.

1. **Are multicellular animal parasites**
2. **Are commonly called worms**
3. **Are the largest organism responsible for human disease**
4. **Are transmitted through fecal contamination or by eating some uncooked meats such as pork**
5. **Parasitic worms live off nutrients in the host's body, in the host's blood, or on the host itself.**
6. **Many parasitic worms have several stages of life involving eggs, larvae, and adult stages.**
7. **Parasitic worms generally inhabit specific body sites.**
8. **For some species of parasitic worms, the inhabited site varies with the stage of development and may even involve more than one host species.**
9. **Mites and lice generally afflict the surface of a host's body and present little direct risk to the host.**
10. **Parasites such as lice, fleas, mosquitoes, and ticks may be vectors of disease.**

**OBJECTIVE 20** **List common parasites that afflict humans.**

1. **Roundworms**
2. **Pinworms**
3. **Hookworms**
4. **Trichinellae**
5. **Flatworms (including flukes and tapeworms)**

**OBJECTIVE 21** **Complete statements concerning the characteristics of viruses.**

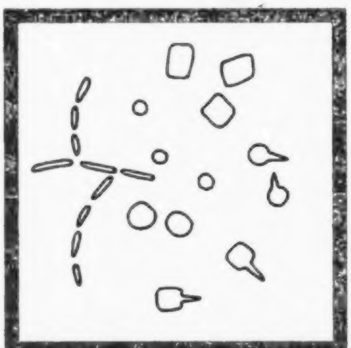

Figure 11
Viruses

1. **Are nucleic acids within shells of protein**
2. **Can only reproduce when they are within the living cells of a host organism**
3. **Will use the nucleic acid and enzymes of an infected cell to produce other viruses, often multiplying to the point that the host cell ruptures and dies**
4. **Severity of a viral disease depends on the type of cells that are infected**
5. **Some viruses can become dormant so that they present no signs of infection and then become active again after a period of time, even years later.**
6. **Some viruses can be transmitted from a pregnant woman to her fetus.**
7. **Antiviral medications are difficult to develop because viruses reside inside cells, use the cell's chemicals to reproduce, and offer few functions that can be attacked without harming the host organism.**
8. **Smallest organism known; can only be seen with the aid of an electron microscope**

   ✔ **NOTE:** Approximately 2,500 viruses could fit on the tip of a pin.

9. **Are highly complex**
10. **Are intracellular parasites**

11. **Each virus exhibits a shape that is characteristic of that virus.**

    - Viruses of human beings and animals are generally spherical in shape.
    - Viruses of plants are rod-shaped or many-sided.
    - Viruses which attack bacteria are known as bacteriophages and are rod-shaped

12. **Viruses themselves have no metabolic functions; they borrow the ribosomes of the host cell to make new viruses.**

13. ***Inclusion bodies* are found in host cells that have been affected by a virus.**

    ✔ **NOTE:** Their presence helps the pathologist diagnose a viral disease.

14. **Viruses may at times stimulate the affected cell to increase in number in a way the cells would not do if they did not contain a virus.**

15. **Viruses are transmitted by both direct and indirect contact.**

16. **Relationship between virus and interferon**

    - Interferon is a protein produced by a normal body cell that is being attacked by a virus.
    - Interferon blocks the effect of the virus and is part of the body's defense against a viral infection.

      ✔ **NOTE:** Research is being done into "interferon inducers," substances that stimulate the cell to produce interferon, which would help to expand our control over viral diseases.

KEY TERM

**Inclusion bodies**—Small, round bodies found in cells affected by a virus

OBJECTIVE 22 **List viral diseases according to type.**

1. **Dermotrophic (affecting the skin and mucous membranes)**
    - Smallpox—*Variola* virus
    - Chickenpox—*Varicella* virus
    - Measles—*Rubeola* virus
    - German measles—*Rubella* virus
    - Fever blisters (cold sores)—*Herpes simplex* virus
    - Shingles (Herpes zoster)—*Varicella-zoster* virus
2. **Pneumotrophic (affecting the respiratory tract)**
    - Common cold (coryza)

- Influenza
- Infectious mononucleosis
- Viral pneumonia

3. **Neurotrophic (affecting the central nervous system)**
    - Poliomyelitis
    - Rabies
    - Encephalitis
4. **Viscerotrophic (affecting a specific organ)**
    - Mumps
    - Viral hepatitis
    - Yellow fever
5. **Immunotrophic (affecting the immune system)**
    - AIDS—HIV

OBJECTIVE 23

## Assignment Sheet 1—Research the Causes and Prevention of a Human Disease

Name ______________________ Date __________

**Evaluation criteria** **Rating**

- Report includes important points mentioned ______
- Report is neat and correct length ______
- Report uses correct grammar, spelling, and punctuation ______
- Report is concise ______

**Overall rating** ______

Evaluator's comments ______________________

**EXERCISE**

**DIRECTIONS**

You may choose a topic from the following list or others selected by you or your instructor. Have your instructor approve any topics not listed. Research the human disease that you chose for your topic. Determine what microorganism(s) causes the disease, effects of the disease, prevention of the disease (if possible), how it is transmitted to others, how transmission can be prevented, and how this disease will affect you as a surgical technologist. In your research, you may also find interesting facts about the disease, the microorganism, or its discovery that you could include in your report. Now, prepare a 1–2 page paper presenting the results of your research. Your instructor may request written or oral reports.

**POSSIBLE RESEARCH TOPICS**

Athlete's foot
Botulism
Chickenpox
Cholera
Common cold
Dysentery
Encephalitis
Fever blisters (cold sores)
Food poisoning
Gastroenteritis
German measles (Rubella)
Gonorrhea
Hepatitis
HIV and AIDS
Infectious mononucleosis
Influenza (various types)
Malaria
Measles (Rubeola)
Meningitis
Mumps
Pneumonia
Poliomyelitis
Rabies
Rheumatic fever
Ringworm
Shingles
Smallpox
Strep throat
Syphilis
Tetanus
Thrush or vaginal thrush
Trichinosis
Tuberculosis
Typhoid fever
Whooping cough
Yellow fever

# Introduction to Surgical Technology

## SECTION C:
## Microbiology

## Module 2-C: Infection and Immunology

## Module Contents

**COMPONENTS**

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# Introduction to Surgical Technology
# Section C: Microbiology
# Module 2-C: Infection and Immunology

**PREREQUISITES:**
**Module 1-C**

## Learning Activities Sheet

Student name ________________________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1.

☐ 5. **Research** Online resources to learn more about infection and immunology. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________
- ________________________________________

☐ 6. **Study** Information Sheet, Objective 2 and Objective 3.

☐ 7. **Do** Assignment Sheet 1, "Determine Human Portals of Entry and Exit for Various Diseases and Infections."

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, repeat steps 6 and 7.

☐ 9. **Study** Information Sheet, Objective 4 through Objective 27.

☐ 10. **Do** Assignment Sheet 2, "Complete a Personal Immunity Survey."

☐ 11. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 12. If the evaluation is not satisfactory, repeat step 10.

☐ 12. **Do** Assignment Sheet 3, "Practice Critical Thinking: Complete a Case Study on Immunity and Infection."

☐ 13. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 14. If the evaluation is not satisfactory, repeat step 12.

☐ 14. **Take** Written Test provided by your instructor.

☐ 15. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 16. If the evaluation is not satisfactory, repeat steps 4, 6, and 9.

☐ 16. **Check** With your instructor for any additional assignments to be completed.

☐ 17. **Do** Additional assignments your instructor lists below.

______________________________________

______________________________________

______________________________________

☐ 18. **Take** Module Review provided by your instructor.

☐ 19. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 20. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the assignment sheets, Written Test, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

# Introduction to Surgical Technology
## Section C: Microbiology
## Module 2-C: Infection and Immunology

### Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to discuss the infectious process and the body's defense mechanisms against disease. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Define the term *infection*.
2. Select true statements concerning human portals of entry.
3. List human portals of exit.
4. Select factors influencing the occurrence of infection.
5. Match types of infections to their correct descriptions.
6. Match the stages of an acute infection to their correct descriptions.
7. Distinguish between direct and indirect contact in the transmission of pathogens.
8. Describe means of controlling the transmission of infections.
9. Complete statements concerning the effects of infection on a human host.
10. List factors that contribute to the spread of nosocomial infections.
11. Match organisms that cause common nosocomial infections to the infections they cause.
12. List the factors that influence the virulence of a pathogen in a host's body.
13. Complete statements concerning the body's defenses against diseases.
14. Select the correct purposes of inflammation.
15. List the symptoms of acute inflammatory response.
16. Select true statements concerning the treatment of acute inflammation.
17. Define the term *immunology*.
18. Distinguish between the types of immune responses.
19. Distinguish between a T cell and a B cell.
20. Match types of T cells and B cells to their correct functions.

21. Describe the types of cellular and tissue defense-mechanism processes the body uses against disease and infection.
22. Describe the phases of the antibody-production cycle that follows the body's exposure to an antigen.
23. Match types of white blood cells to their correct descriptions.
24. Select true statements concerning the types of immunity.
25. Match types of acquired immunity to their correct descriptions.
26. List types of vaccines.
27. Complete statements concerning the allergic response.
28. Complete statements concerning the characteristics of anaphylaxis.
29. Select true statements concerning the rejection syndrome.
30. Determine human portals of entry and exit for various diseases and infections. (Assignment Sheet 1)
31. Complete a personal immunity survey. (Assignment Sheet 2)
32. Practice critical thinking: complete a case study on immunity and infection. (Assignment Sheet 3)

## Information Sheet

OBJECTIVE 1

**Define the term *infection*.**

- **Infection**—An invasion of the body by organisms and the reaction of the body to the presence of those organisms and to the **toxins** they produce; the presence of and multiplication of an organism that results in harm or **disease** to a **host**

KEY TERMS

**Toxin**—A substance that is harmful to cells

**Disease**—A specific illness or disorder characterized by a recognizable set of signs and symptoms and attributable to heredity, infection, diet, or environment

**Host**—An organism that serves as a permanent or temporary home for another organism

OBJECTIVE 2

**Select true statements concerning human portals of entry.**

1. **Portals of entry are specific pathways by which a microorganism enters the body that result in an infection.**
2. **A portal of entry may be a natural opening, such as the mouth, or an injury, such as a cut.**
3. **Portals of entry include:**
   - **Skin**
     - Skin must be broken to act as a portal of entry. Unbroken skin is the body's first line of defense against infection.
     - Common microorganisms entering through the skin cause tetanus, gas gangrene, staphylococcal infection, and streptococcal infection.

       ✔ **NOTE:** Generally, these are **opportunistic microorganisms** which pose no threat of infection unless the skin is broken.
   - **Respiratory tract**
     - Many microorganisms enter through the mouth and nose into the respiratory tract.
     - This is the most frequent route of infection.
     - Microorganisms entering through this route cause tuberculosis, pneumonia, common cold, measles (rubeola), German measles (rubella), scarlet fever, and smallpox.

- **Alimentary tract**
  - Microorganisms known as intestinal or enteric microorganisms enter through the mouth into the stomach and gastrointestinal (GI) tract.
  - Microorganisms entering through this route include those causing typhoid fever, hepatitis A and E, bacillary and amebic dysentery, and cholera.

    ✔ **NOTE:** These diseases are most commonly seen in areas with poor sanitation and are transmitted through contaminated food or water.
- **Genitourinary (GU) tract**
  - These enter through the mucous membranes of the urinary and/or the reproductive systems.
  - Microorganisms entering through this route include those causing urinary tract infections, HIV (AIDS), and **sexually transmitted diseases**.

    ✔ **NOTE:** Urinary infections are usually the result of migration of microorganisms from the rectal area.

KEY TERMS

**Opportunistic microorganisms**—Microorganisms that do not normally invade tissue but that are capable of causing infection or disease when introduced mechanically or when host resistance is lowered

Example: *Tetanus bacillus* must be introduced by injury. On unbroken skin it will not cause infection.

**Sexually transmitted disease (STD)**—Disease acquired as a result of sexual intercourse with an infected individual

Examples: Syphilis, gonorrhea, chancroid, chlamydia, genital herpes, genital warts

- **Placenta**
  - Microorganisms from the pregnant mother will penetrate the placenta and infect the fetus.
  - Microorganisms entering through this route cause syphilis, HIV (AIDS), smallpox, and German measles.
- **Circulatory system**
  - Microorganisms enter by invasion into the bloodstream.
  - These microorganisms, including hepatitis B (HBV) and HIV, can be transmitted by contaminated blood transfusions, needle sticks, or cuts from sharp objects which had contaminated blood or body fluids.

— Some microorganisms, such as those causing yellow fever and malaria, may also be transmitted through bites from insects.

✔ **NOTE:** HIV is not transmitted through insect bites.

OBJECTIVE 3 **List human portals of exit.**

1. **The pathway by which microorganisms leave the body depends largely upon the part of the body affected by the disease.**

2. **All body secretions and excretions are potential portals of exit if they contain any component of blood.**

3. **Infections can be spread to others through portals of exit.**

   Example: Someone sneezes, pathogens exit with the mucous and **droplets** expelled from the nose become airborne.

4. **Pathogens are spread by persons coming into contact with the body fluids that leave by means of an infected person's portals of exit.**

   Example: Blood may be transferred from an open wound or by infected needles and instruments.

5. **Hosts who have recovered from a disease or who are asymptomatic may be *carriers* and transmit the disease to others.**

6. **Common portals of exit include:**

   - **Blood**—Includes microorganisms causing hepatitis B and HIV

     ✔ **NOTE:** These are bloodborne pathogens and are of a major concern to health-care workers.

   - **Fecal matter (feces)**—Includes microorganisms causing hepatitis, polio, and dysentery
   - **Urine**—Includes microorganisms causing typhoid fever
   - **Respiratory secretions (*sputum*)**—Includes microorganisms causing tuberculosis, pneumonia, and the common cold
   - **Saliva**

     — Includes microorganisms causing strep throat and the common cold

     ✔ **NOTE:** HIV may be transmitted in saliva ONLY if it contains blood or blood components.

     — Some diseases of animals can be transmitted to humans from its primary animal host by saliva.

     Examples: Rabies, equine encephalitis, yellow fever

     ✔ **NOTE:** *Zoonosis* refers to diseases that are communicable from animals to humans.

- **Tears**—Includes microorganisms causing conjunctivitis
- **Semen and vaginal secretions**—Includes microorganisms causing HIV (AIDS) and sexually transmitted diseases

  ✔ **NOTE:** Semen contains white blood cells.

- **Other body fluids that may contain infectious blood cells**
  - Cerebrospinal fluid (CSF)
  - Synovial fluid
  - Pericardial fluid
  - Peritoneal fluid
  - Amniotic fluid
  - Breast milk
  - Vomit

KEY TERMS

**Droplets**—Very small masses of liquid carried in a spray from the nose or mouth which fall to surfaces upon expiration as liquid and which are not readily inhaled

**Carriers**—Persons who harbor pathogens without being sick themselves and who shed organisms into the environment

**Sputum**—Substance expelled by coughing or clearing the throat

✔ **NOTE:** Sputum may contain a variety of materials from the respiratory tract, including cellular debris, mucus, pus, blood, and microorganisms.

OBJECTIVE 4 **Select factors influencing the occurrence of infection.**

1. **Portal of entry**

   ✔ **NOTE:** Most organisms will cause infection only when they enter a particular pathway. For example, swallowing malarial organisms would not cause the disease; they must enter through the bloodstream.

2. **Number of organisms**

   ✔ **NOTE:** The normal body defenses can usually control a few organisms, but when large numbers are introduced, they usually cause an infection.

3. ***Virulence* of the organism**

✔ **NOTE:** Organisms are more virulent if they produce hemolysins, coagulase, enzymes, **endotoxins**, or **exotoxins**. The presence of a capsule also increases the virulence.

4. **Resistance of host**

✔ **NOTE:** Resistance determines whether or not infection will take place and the severity of the disease. Some individuals can withstand infection more easily than others.

KEY TERMS

**Virulence**—Relative power of a pathogen to cause disease

**Endotoxins**—Bacterial toxins which are liberated only when the bacterial cell is destroyed

**Exotoxins**—Bacterial toxins which diffuse from bacterial cells into surrounding medium

OBJECTIVE 5 **Match types of infections to their correct descriptions.**

1. **Primary infection**—First or original infection; first occurring infection within a period of illness

2. **Secondary infection**—Infection that follows or complicates the original disease; a subsequent infection or complication to an existing condition

   ✔ **NOTE:** This type of infection is usually caused by opportunist-type organisms.

3. **Latent infection**—Infection that is inactive or hidden; no apparent symptoms

   Examples: Early tuberculosis, tertiary syphilis, undulant fever, malaria

4. **Mixed infection**—Infection that is caused by more than one organism

   Examples: Appendicitis, wound infections, trench mouth (Vincent's angina)

5. **Acute infection**—Infection that runs a rapid and severe course terminating abruptly

   Examples: Cold, measles, influenza

6. **Chronic infection**—Infection that runs a slow course over a long period of time; may last from weeks to years

   Examples: Tuberculosis, syphilis, fungal infections, AIDS

   ✔ **NOTE:** In some cases, such as undulant fever, the disease begins as an acute infection, and if not properly treated, becomes chronic.

7. **Localized infection**—Infection that involves only one organ or site of a host's body

   ✔ **NOTE:** A localized infection may also be referred to as a *local infection*.

8. **Systemic infection**—Infection that has spread throughout a host's body from an initial site

9. **Nosocomial infection**—Infection that is contracted in a hospital or other health-care facility, such as a nursing home

   ✔ **NOTE:** Nosocomial infections often result from poor health-care practices.

OBJECTIVE 6 **Match the stages of an acute infection to their correct descriptions.**

1. **Incubation**—Period of time between entrance of organisms to the body and onset of symptoms in a host

   ✔ **NOTE:** The length of incubation period varies with the type of disease.

2. **Prodromal**—Short period, usually a day or less, when the infection has been established but symptoms are not fully developed; the host may not feel well, but symptoms are vague

3. **Acute**—Period of actual illness with symptoms, degree of fever, and length of time depending upon the disease, condition of patient, and treatment

4. **Convalescent**—Begins with decline of fever and acute symptoms; length of time depends upon the severity of the acute stage, treatment, and general health of the patient

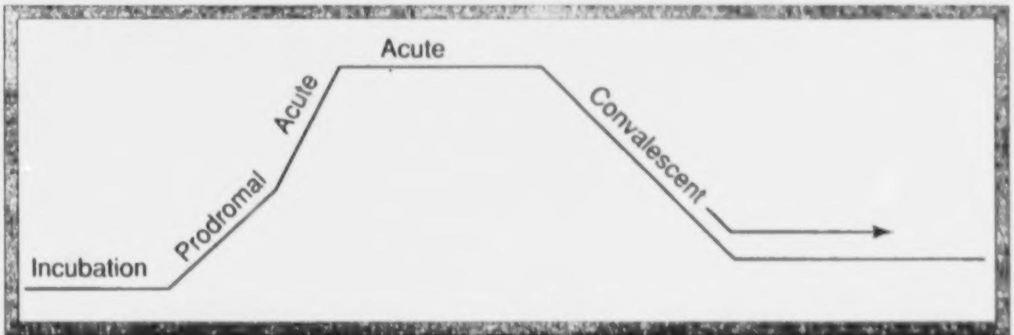

**Figure 1**
Stages of an acute infection

✔ **NOTE:** Most illnesses are called *self-limiting*—the body's defenses will overcome the illness in a short time, or the disease is caused by a **pathogen** that has only a short life cycle within the body. Some illnesses require the use of medications to assure recovery. In some cases, a host does not recover quickly, and some diseases can lead to the host's death. If the disease is not fatal, it does not lead to the host's death—the host may remain afflicted, with the disease becoming chronic. Often chronic illnesses do not lead directly to death, but they may allow secondary infections that can lead to death or that are fatal to the host because of his or her weakened condition from dealing with the chronic condition.

KEY TERM

**Pathogen**—Disease-causing microorganism

OBJECTIVE 7

**Distinguish between direct and indirect contact in the transmission of pathogens.**

1. **Direct contact**

   - Transmission of a contagious disease by a healthy person coming in contact with a person who is a carrier of or has the disease

     Example: Patient to worker, patient to patient

   - Can also include direct animal-to-person contact

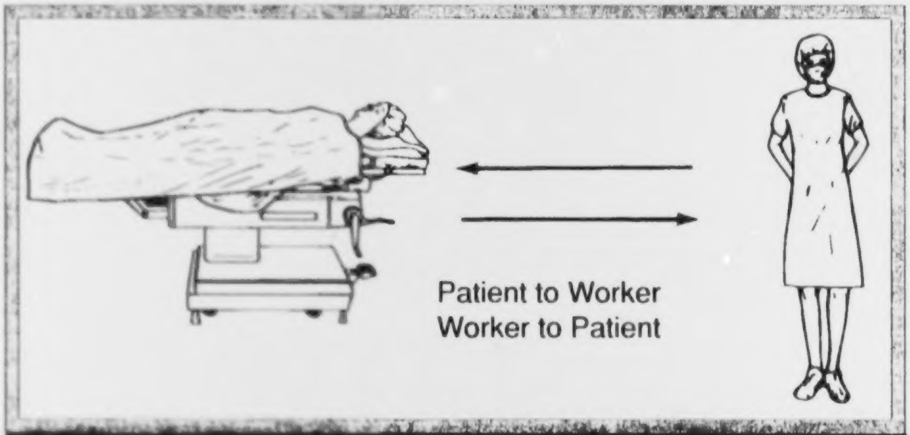

Figure 2
Direct contact

2. **Indirect contact**

- Denotes the spread of contagious disease by some **medium** other than directly touching an infected person
- Media include:
  - Contaminated food and water

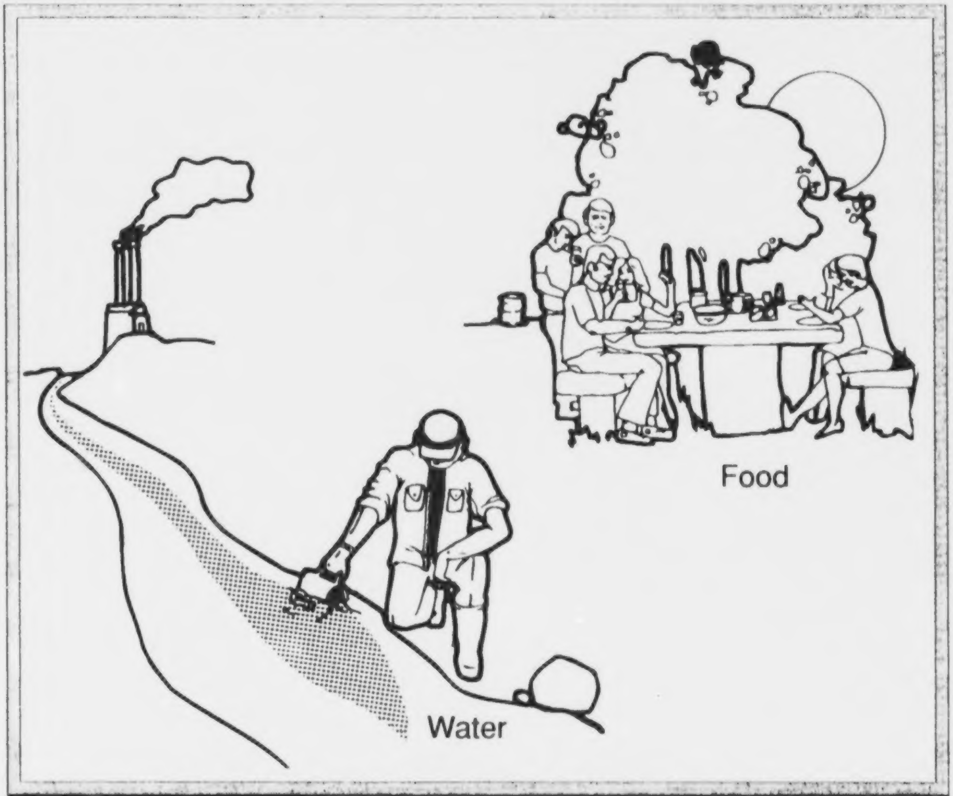

**Figure 3**
Indirect contact Contaminated food and water

  - **Fomites** (inanimate objects)

    Examples: Bedpans, sheets, drinking cups, tables

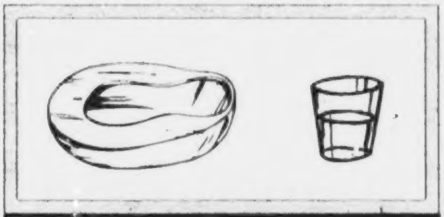

**Figure 4**
Fomites

— **Vectors**

Examples: Flies, ticks, mosquitoes, mites

✔ **NOTE:** Vectors may carry pathogens inside their bodies and transfer this biologically through a bite as in Rocky Mountain spotted fever, or they may carry pathogens on their bodies and simply mechanically transfer these microorganisms as when flies land on food.

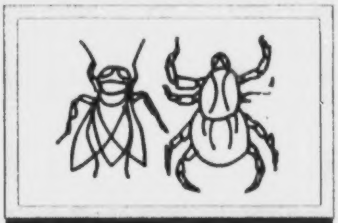

**Figure 5**
Vectors

Key Terms

**Medium**—Agent through which microorganisms are transmitted

**Fomites**—Inanimate objects which are freshly contaminated with secretions or excretions from an infected person or carrier

**Vector**—An animal, especially an insect, that transmits pathogens from infected to noninfected individuals

— Dirt, dust

**Figure 6**
Dust

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- Air molecules

✓ **NOTE:** **Droplet nuclei** are transmitted through air molecules.

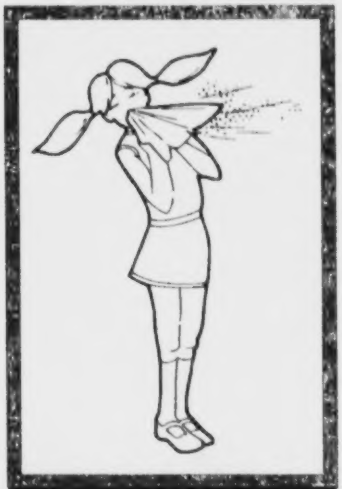

Figure 7
Through Air

KEY TERM

**Droplet nuclei**—Very small masses of liquid carried in a spray from the nose or mouth which evaporate before settling and remain suspended in the air

OBJECTIVE 8

**Describe means of controlling the transmission of infections.**

1. **Spread of infection can be reduced by using antiseptic practices, cleaning with disinfectants, and sterilizing instruments and surgical materials.**
2. **Some infections can be prevented by using vaccinations.**
3. **Antibiotics can be used to fight infections.**
4. **Portal of entry transmission control methods**
   - Wash hands.
   - Place sterile bandages over wounds.
   - Wear masks over nose and mouth.
   - Wear protective eyewear/face shields in case of splashing.
   - Use insect repellent.

- Do not eat or drink contaminated food or beverages.
- Properly clean after urination and defecation.
- Have required vaccinations.
- Use only sterile supplies for invasive procedures (injections, etc.).
- Cleanse the proposed incision site.
- Provide a sterile environment and supplies in surgery.

5. **Portal of exit transmission control methods**

- Bandage draining sores or wounds.
- Wear gloves and change after **contamination**. Also wash hands after removing gloves.*
- Wear masks over nose and mouth.*
- Wear protective eyewear/face shields.*
- Wear protective aprons/gowns (impermeable clothing).*
- Properly handle/dispose of contaminated articles such as instruments, linens, etc. and medical waste products.*
- Properly handle/dispose of sharps (needles, blades).*
- Use "no touch" passing of sharp instruments and blades.*
- **Decontaminate** all surfaces and devices after use.*

✔ **NOTE:** * Indicates use of **Standard Precautions**.

KEY TERMS

**Contamination**—Transmission of microorganisms from person to person or from object to person and vice versa

**Decontamination**—The process of removing organisms from articles, rooms, and linen after their use to make them safe to handle; may involve **terminal sterilization**

**Terminal sterilization**—Process of sterilizing articles after they have been used and before putting them into circulation again

**Standard Precautions**—Guidelines recommended by the Centers for Disease Control (CDC) to prevent the transmission of bloodborne pathogens

6. **Vectors or carriers of infection transmission control methods**

   - Sterilize or disinfect fomites.
   - Disinfect air.
   - Use dust control measures.
   - Properly handle food, water, and milk.
   - Control insects.
   - Vaccinate household pets for rabies.

OBJECTIVE 9

**Complete statements concerning the effects of infection on a human host.**

1. **The harmful effects of an infection on a host may be a direct result of an action taken by a pathogen or the result of toxins produced by the pathogen.**
2. **An infecting organism generally causes illness by disrupting normal activities of a host's cells.**
3. **The infecting organism's virulence depends on how the organism enters the body and the number of invading pathogens.**
4. **An infection may result in observable symptoms or occur without symptoms.**
5. **The period of time between the incidence of infection and the appearance of symptoms in a host is referred to as the incubation period.**
6. **An infection in a host may be localized, limited to only one organ or site, or it may be systemic, affecting the entire body.**
7. **The host's body produces antibodies in response to the presence of an *antigen*. These antibodies recognize pathogens and destroy them.**
8. **Communicable diseases are infections that can be spread from one host to another through direct or indirect contact.**
9. **The ability of a host to avoid infection and reduce harm caused by an infecting organism is called *resistance*. The resistance of a host depends on factors such as general health, age, and sensitivity to pathogens.**

KEY TERM

**Antigen**—A substance which induces the formation of antibodies; may be introduced into the body or formed within the body

Examples: Bacteria, bacterial toxins, foreign blood cells

✔ **NOTE:** The body does not recognize antigens as "belonging" there.

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OBJECTIVE 10

**List factors that contribute to the spread of nosocomial infections.**

1. **Improper hand-washing techniques**
2. **Inappropriate use of antibiotics**

   ✔ **NOTE:** Excessive use of antibiotics can cause pathogens to become resistant to the effects of the medication. Antibiotics can also destroy resident flora, allowing other organisms to gain a competitive advantage.

3. **Surgical procedure**

   ✔ **NOTE:** Some types of surgeries are more likely to lead to infection than others. Surgeries involving the abdomen, especially the intestines, may expose other parts of the body to resident microbes that are normally nonpathogenic. Burns, trauma, and other injuries that break the surface of the skin and make it difficult to close off portals of entry are more likely to become infected.

4. **Specimen and tissue handling**
5. **Administration of immunosuppressive agents**

   ✔ **NOTE:** Immunosuppressive agents are given to patients who have had tissue transplants to reduce the chances of rejection. Persons receiving these agents are more likely to contract other infections because of their reduced defense mechanisms.

OBJECTIVE 11

**Match organisms that cause common nosocomial infections to the infections they cause.**

1. **Esherichia coli**—Responsible for various infections referred to as *colitis*

   ✔ **NOTE:** *E. coli* normally reside in the human intestinal tract with no ill effect; however, during surgical procedures, the microbes may be spread to other parts of the body where they can cause various infections. *E. coli* is one of the most-common sources of nosocomial infections.

2. **Hepatitis B virus**—Responsible for hepatitis

   ✔ **NOTE:** Hepatitis B virus is one of three common strains, though other strains exist. Hepatitis B is a significant threat in health care because it can be spread through body fluids.

3. **Human immunodeficiency virus (HIV)**—Responsible for AIDS

   ✔ **NOTE:** HIV is of particular concern to health-care workers because it can be spread through body fluids.

4. **Human papilloma virus**—Associated with several types of cancer, including cancers of the mouth and cervix
5. **Mycobacterium species**—Responsible for tuberculosis and leprosy and present a particular hazard for various infections to patients with low resistance, such as those with acquired immunodeficiency syndrome (AIDS), to those receiving immunosuppressors, and to those with pulmonary conditions

   ✔ **NOTE:** Some mycobacterium species are found in the lungs with no ill effects on the host.

6. **Pseudomonas aeruginosa**—Presents a particular hazard for various infections to burn victims, patients with cystic fibrosis, and those patients with certain types of cancer where the skin and mucous membranes do not afford adequate protection

   ✔ **NOTE:** *Pseudomonas aeruginosa* normally inhabits soil and water and is a transient flora for the intestines.

7. **Staphylococcus aureus**—Responsible for a number of postoperative infections commonly referred to as *staph infections*

8. **Streptococcus species**—Involved in "strep" throat, scarlet fever, pneumonia, rheumatic heart disease, and other communicable conditions

OBJECTIVE 12 **List the factors that influence the virulence of a pathogen in a host's body.**

1. **Overall health of the host**
2. **Number of organisms that are able to invade the host**
3. **Strength of toxins produced by the organism**
4. **Amount of toxins produced by the organism**

OBJECTIVE 13 **Complete statements concerning the body's defenses against diseases.**

1. **Physical and chemical barriers**

   - The body's first line of defense to prevent invasion of many pathogens

     Examples: Intact skin, mucous membranes, gastric secretions, tears, cerumen, saliva, normal flora in portals of entry

2. **Inflammatory response**

   - Local tissue reaction to various cell injuries such as from foreign bodies, chemicals, microorganisms, or trauma
   - White blood cells begin **phagocytosis** to eliminate damaged tissue.

3. ***Immune* response**

   - Reaction to an antigen that the body identifies as foreign
   - Involves the production of **lymphocytes** (T cells or B cells) with **antibody** formation

   ✔ **NOTE:** The body uses barriers and inflammation against a variety of diseases and foreign impurities. However, the immune system is the body's defense against **specific** agents (antigens).

KEY TERMS

**Phagocytosis**—The act of a cell engulfing a foreign particle

**Immune**—Not susceptible or responsive to a disease or having high degree of resistance to a disease

**Lymphocytes**—Type of white blood cell that assists in immunity; include T cells and B cells

**Antibody**—Protein substance developed by the body in response to the presence of an antigen that counteracts the antigen

✓ **NOTE:** Antibodies develop a very specific defense to each antigen.

OBJECTIVE 14 **Select the correct purposes of inflammation.**

1. **To localize infection**
2. **To prevent the spread of pathogens**
3. **To destroy pathogens**
4. **To heal and repair damaged tissue**

OBJECTIVE 15 **List the symptoms of acute inflammatory response.**

1. **Redness**
2. **Heat**
3. **Swelling**
4. **Pain**
5. **Disordered (impaired) function**

OBJECTIVE 16 **Select true statements concerning the treatment of acute inflammation.**

1. **Rest for the inflamed part**

   ✓ **NOTE:** This is the most important treatment. Exercise or movement of the part not only increases inflammation but helps to spread pathogens.

2. **Application of moderate heat to dilate blood vessels and increase flow of blood and its white cells and antibodies to the affected part**
3. **Open drainage to allow bacteria to escape and to relieve tension and swelling of inflamed part**
4. **Supplement body's natural defenses with specific drugs such as antibiotics**

**OBJECTIVE 17** **Define the term *immunology*.**

- **Immunology**—The study of the ways in which the body resists infection

**OBJECTIVE 18** **Distinguish between the types of immune responses.**

1. **Cell-mediated immune response**
   - Involves the production of T cells in response to exposure to an antigen (mainly viral antigens)
   - Is a delayed response important in tissue transplant rejection, delayed hypersensitivity, and defense against some infections

   ✔ **NOTE:** Memory T cells are ready to take action if there is future invasion of the antigen. B cells are not involved in this response. Therefore, no antibodies are formed. Memory T cells take on the responsibility of fighting off future attacks by the antigen.

2. **Humoral immune response**
   - Involves the production of B cells and some T cells in response to exposure to an antigen. The B cells then produce antibodies.
   - May produce immunity or hypersensitivity

   ✔ **NOTE:** Memory B cells stand guard ready to initiate the production of antibodies if the antigen is reintroduced.

**OBJECTIVE 19** **Distinguish between a T cell and a B cell.**

1. **T cell**—Type of lymphocyte that is formed either in the fetal thymus gland or in the bone marrow and passes through the thymus on its way to the lymph nodes and spleen
2. **B cell**—Type of lymphocyte that is formed in fetal bone marrow and moves directly to the lymph nodes and spleen

**OBJECTIVE 20** **Match types of T cells and B cells to their correct functions.**

1. **Helper T cells**—Seek out phagocytes that have engulfed pathogens and examine the antigens of captured pathogens; may also present the foreign antigen to B cells

   ✔ **NOTE:** Phagocytes present the antigens of a captured pathogen to helper T cells, which become sensitized to the pathogen.

2. **Sensitized helper T cells**—Divide rapidly to produce memory, cytotoxic, and suppressor T cells
3. **Memory T cells**—Carry the imprint of a particular pathogen's antigens and store the imprint in preparation for future invasions of the pathogen

4. **Cytotoxic T cells**—Chemically rupture the cell membrane of infected cells to prevent the pathogen from reproducing and also produce chemicals called *cytokines* that attract phagocytes to the area where the pathogen is located

   ✔ **NOTE:** Cytotoxic T cells are also referred to as *killer T cells*. The rupturing of the pathogen's cell membrane is referred to as *lysis*.

5. **Suppressor T cells**—Suppress the immune response once a foreign antigen has been destroyed
6. **Inactive B cells**—Reside in the liver, spleen, and lymph nodes until exposed to the antigen of their target pathogen
7. **Activated B cells**—Divide into memory B cells and plasma cells
8. **Memory B cells**—Remember the antigen and will become involved in responding to any subsequent invasion by that pathogen
9. **Plasma cells**—Produce antibodies specific to a pathogen's antigen and tag the pathogen cells for destruction by phagocytes

OBJECTIVE 21

**Describe the types of cellular and tissue defense-mechanism processes the body uses against disease and infection.**

1. ***Interferon* response**—The process by which a cell releases chemicals that interfere with a virus' ability to reproduce within a cell

   ✔ **NOTE:** In order to reproduce, viruses must be inside cells. However, the virus cannot multiply and spread if it does not reproduce. While interferon does not prevent the infection of that particular cell, it does prevent the virus from reproducing viruses that could spread to other cells. Artificial interferon is used to fight cancer because of this effect.

2. **Phagocytosis**—The process in which a moving cell engulfs a mass of foreign material

   ✔ **NOTE:** Blood consists of three major types of cells: red blood cells, white blood cells, and platelets. White blood cells play an important role in the body's defense mechanisms. For example, one function of certain white blood cells is to clean up dead cells and other debris of metabolism. They perform this function by surrounding the debris through phagocytosis. White blood cells can also perform phagocytosis on invading pathogens as a defense mechanism.

3. ***Serum*-protein response**—The process by which components of the blood and lymph analyze captured pathogens to help develop immunity reactions to the pathogens

   ✔ **NOTE:** Serum proteins are components of blood and lymph.

4. **Inflammatory reaction (inflammatory response)**—The process by which tissues in an area of injury or infection work to trap pathogens in the area

   ✔ **NOTE:** The interferon response, phagocytosis, and the inflammatory reaction are all intended to provide a defense against a present, immediate pathogen threat. The serum-protein responses provide immediate defense, but they also help to improve the body's immunity as a defense against future invasions of that pathogen (resistance).

KEY TERMS

**Interferon**—An antiviral protein produced by cells infected with a virus and by T cell lymphocytes

✔ **NOTE:** Interferon prevents the cells containing the virus from reproducing.

**Serum**—Watery fluid taken from the blood of an animal rendered immune against a pathogenic organism which is injected into a patient to protect against the disease resulting from the pathogenic organism

OBJECTIVE 22

**Describe the phases of the antibody-production cycle that follows the body's exposure to an antigen.**

✔ **NOTE:** The following cycle occurs whether the initial infection occurs naturally or as a result of a **vaccination**.

1. **Lag phase**—The phase during which the body detects an unrecognized foreign antigen and begins to react

   ✔ **NOTE:** Generally, the body produces antibodies only after an exposure to an unrecognized foreign antigen. The body recognizes its own antigens and usually only attacks foreign antigens.

2. **Primary-response phase**—The phase during which the body produces (1) antibodies that "fit" the previously unrecognized antigen and (2) memory cells that will recognize that antigen during any subsequent exposure

   ✔ **NOTE:** The number of antibodies produced during the primary-response phase is generally not enough to prevent an infection, so the person usually becomes sick. After the invading antigens are removed from the body following an illness, the number of antibodies in the bloodstream declines, but the memory cells remain.

3. **Secondary-response phase**—The phase during which the body is exposed to a subsequent invasion by an antigen, the memory cells immediately recognize the antigen, and the body produces antibodies against it

   ✔ **NOTE:** If there is a second invasion by a foreign antigen, the body immediately recognizes the antigen and begins to produce antibodies based on the "memory" of the first infection. Consequently, in many cases, the body is able to produce enough antibodies in a short enough time to prevent the antigen from becoming established, and the person may not become sick.

KEY TERMS

**Vaccination**—Inoculation with a **vaccine**

**Vaccine**—Suspension of infectious agents given to establish resistance to an infectious disease

Example: Pneumococcal polysaccharide vaccine will protect against *Streptococcus pneumonia* (pneumococcal bacteria).

**Immunization**—Process of rendering a patient immune

✔ **NOTE:** Vaccination is only one type of immunization.

OBJECTIVE 23 **Match types of white blood cells to their correct descriptions.**

✔ **NOTE:** Five types of white blood cells are described below. Each type of white blood cell or leukocyte plays a role in one or more of the cell and tissue defense mechanisms. Additionally, for each type of white blood cell, there are variations that serve specific purposes in the body's response to pathogen invasion.

1. **Neutrophil**—A type of white blood cell that is the first to respond to an inflammatory reaction, where it performs phagocytosis on pathogens

   ✔ **NOTE:** Neutrophils make up approximately 55 to 70 percent of the white blood cells. Neutrophils provide a quick response that is not as organized and specific as subsequent reactions. Basically, they charge into the infected site and begin attacking foreign materials.

2. **Lymphocyte**—One of two types of white blood cells—a T cell or a B cell—that performs various functions related to recognizing, marking, and remembering pathogens based on their antigens

   ✔ **NOTE:** Approximately 20 to 35 percent of the white blood cells are lymphocytes.

3. **Monocyte**—A type of white blood cell that enlarges to form a **macrophage** in order to perform more-rapid phagocytosis

   ✔ **NOTE:** Monocytes compose 3 to 8 percent of all white blood cells. Many specialized macrophages are found throughout the body, where they often are named for the structures with which they are associated. For example, macrophages in the lungs are referred to as *alveolar macrophages*, those in the brain are called *brain microglia*, and those in the liver are *Kupffer cells.* In addition to attacking pathogens, macrophages engulf and dispose of dead and damaged tissue. This function supports the inflammatory response and aids in tissue repair.

4. **Eosinophil**—A type of white blood cell that is believed to neutralize toxins such as those secreted by some pathogens

   ✔ **NOTE:** Eosinophils make up 1 to 3 percent of the body's white blood cells. In their detoxification role, they are also important in dealing with allergic reactions.

5. **Basophil**--A type of white blood cell that, as part of the inflammatory reaction, releases chemicals that allow the capillaries to be penetrated by white blood cells and other substances that accumulate at an infection site

   ✔ **NOTE:** Basophils represent less than 1 percent of the total number of white blood cells. They contain granules of **heparin** and **histamine**.

KEY TERMS

**Macrophage**—Type of white blood cell that engulfs foreign particles

**Heparin**—A chemical that helps prevent abnormal blood clotting

**Histamine**—A chemical that makes capillaries more permeable

OBJECTIVE 24

**Select true statements concerning the types of immunity.**

1. **Genetic (inborn) immunity**
   - Is programmed into one's genetic makeup
   - Does not involve antibodies
   - Varies between individuals, nationalities, racial groups, and species

     ✔ **NOTE:** An organism that infects one person may not infect someone from another group.
2. **Acquired immunity**
   - Involves the use of antibodies
   - May be naturally acquired or artificially acquired
   - May be active or passive

**Objective 25** **Match types of acquired immunity to their correct descriptions.**

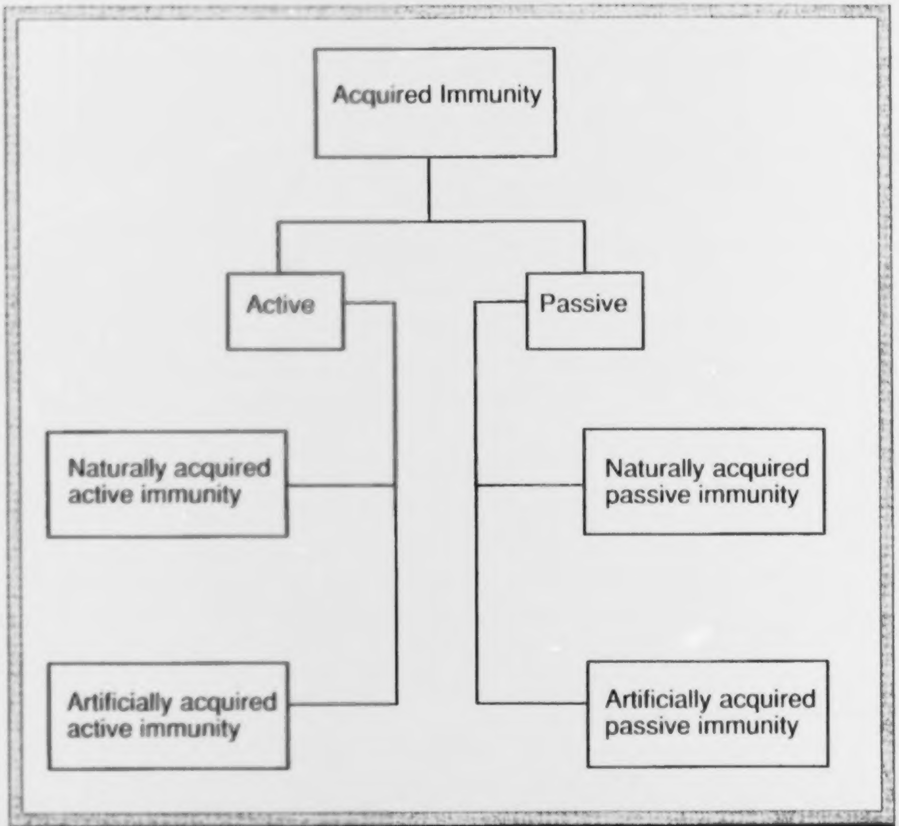
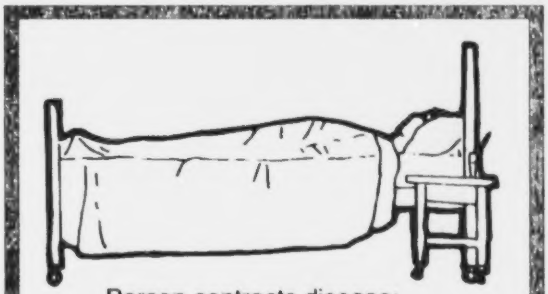

Acquired Immunity
Active
Passive
Naturally acquired active immunity
Artificially acquired active immunity
Naturally acquired passive immunity
Artificially acquired passive immunity

**Figure 8**
Types of acquired immunity

1. **Active immunity**—Body produces its own antibodies in response to antigens.

- **Naturally acquired active immunity**—Individual contracts disease, and then produces own antibodies to that specific disease and long term memory cells to that disease (antigen).

  ✔ **NOTE:** When the individual is exposed to this disease again, the memory cells will quickly produce the needed antibodies to protect the individual who is now immune to that disease.



Person contracts disease; manufactures antibodies; immunity is long-term.

**Figure 9**
Naturally acquired active immunity

- **Artificially acquired active immunity**—Individual is administered a vaccine; body then produces antibodies to the antigen.

  ✔ **NOTE:** Although active immunity produces long-term immunity, it may not last a lifetime. Booster shots may be required to maintain a high enough level of antibodies to prevent the disease.

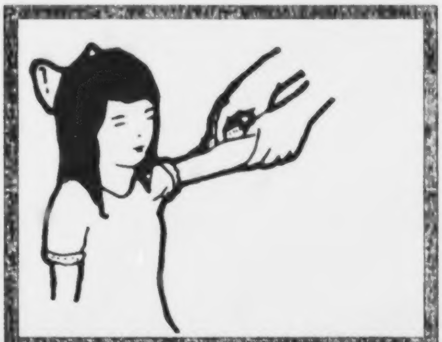
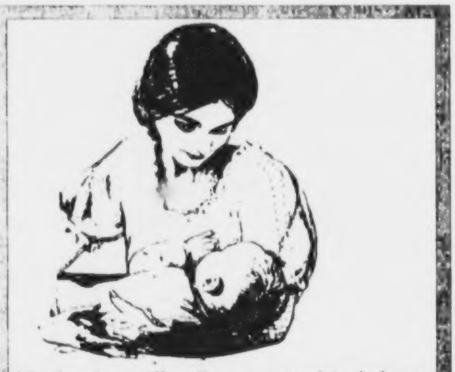


**Figure 10**
Artificially acquired active immunity

2. **Passive immunity**—Antibodies from an outside source are introduced into the body; body does not have to produce its own antibodies.

   - **Naturally acquired passive immunity**—Mother's antibodies pass through placenta to fetus or through breast milk to infant.



Mother's antibodies passed to infant. Immunity is short-term.

Figure 11
Naturally acquired passive immunity

- **Artificially acquired passive immunity**—Antibodies produced elsewhere are injected in the form of immune serums.

✔ **NOTE:** Immune serums may be prepared in animals (such as horses), other humans, or in the laboratory. Immune serums (antiserums) only provide short-term immunity with no memory against future invasions. These are not like vaccines which give long-term immunity.

Examples: Immune globulin (gamma globulin) contains special antibodies and is commonly give to boost immunity when individuals have been exposed to Hepatitis A virus. Snake antivenin is a passive antiserum containing **antitoxin** to snake venom and is given to snake-bite victims.

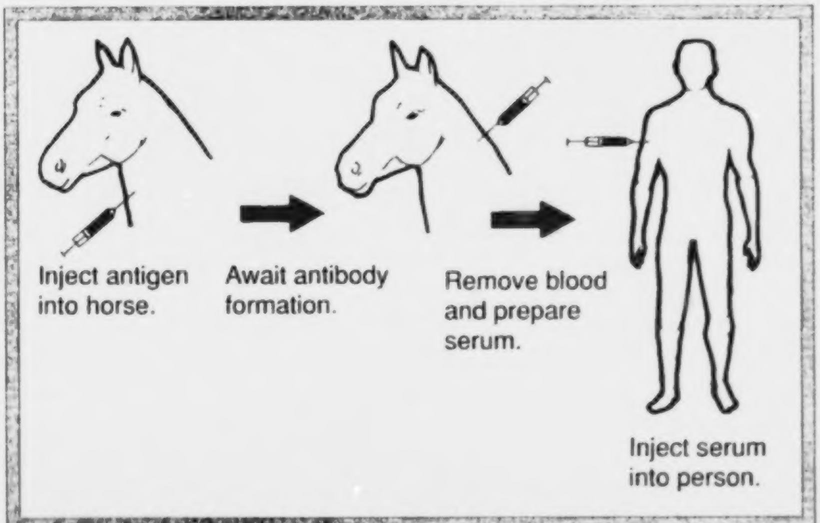

Inject antigen into horse.
Await antibody formation.
Remove blood and prepare serum.
Inject serum into person.

**Figure 12**
Artificially acquired passive immunity

KEY TERM

**Antitoxin**—An antibody capable of neutralizing a specific toxin

OBJECTIVE 26 **List types of vaccines.**

1. **Living attenuated pathogens**—Contain live, weakened, or less virulent forms of the target pathogen

   Examples: Live oral polio vaccine and live attenuated measles vaccine

2. **Killed (inactivated) pathogens**—Contain nonliving or inactivated pathogens

   Examples: Vaccines for rabies, influenza, pertussis (whooping cough), and typhoid fever

3. **Toxoids**—Contain toxins of the pathogen

   Examples: Vaccines for diphtheria and tetanus

4. **Extracts of pathogens (such as bacterial capsule)**—Contain components of the pathogen

   Examples: Pneumococcal polysaccharide vaccine and *Haemophilus b* conjugate vaccine

OBJECTIVE 27

**Complete statements concerning the allergic response.**

1. **Is basically an antigen—antibody reaction**
2. **Is brought on by allergens which cause altered reactions in the body tissue of sensitized individuals but which produce no effect in nonsensitized (nonallergic) individuals**
3. **Does not occur on first contact with potential *allergen* because antibodies have not yet been produced. An allergic response may occur the second time a person is exposed to the allergen or may not occur for years until repeated exposures have produced enough antibodies to trigger the response.**
4. **Allergic reactions can range from itching, redness of skin, and headache to breathing difficulties and anaphylaxis.**
5. **Treatment may include avoiding the allergen, desensitization, or use of antihistamines.**
6. **Common allergens include**
   - Inhalants such as dust, pollen, and perfume
   - Foods such as wheat, eggs, milk, chocolate, and strawberries
   - Drugs such as aspirin and various antibiotics and serums
   - Other contactants such as animals, plants, hair, and fur

KEY TERMS

**Allergen**—Any substance that brings on the manifestations of an **allergy**

**Allergy**—Abnormal hypersensitivity by an individual to one or more substances

OBJECTIVE 28

**Complete statements concerning the characteristics of anaphylaxis.**

1. **Is a severe allergic reaction to a drug such as penicillin or a foreign protein such as insect venom**
2. **Hypersensitive body cells reacting to the drug release histamine or a histamine-like substance, causing vasodilation, hypotension, and bronchiolar constriction.**

3. **Reactions which constitute anaphylactic shock include:**
   - Irritability
   - Dyspnea
   - Cyanosis
   - Unconsciousness
   - Convulsions and possibly death
4. **Anaphylactic reactions occur suddenly, within minutes.**
5. **Reactions vary but in extreme cases death may occur if emergency treatment is not given.**

   ✔ **NOTE:** Death usually results from the spasm of muscles in the bronchioles.
6. **Treatment includes vasopressor agents, especially epinephrine, as well as antihistamines, corticosteroids, and oxygen by positive pressure.**
7. **Serum sickness is an anaphylactic reaction which occasionally follows injection of foreign serums, especially horse serums.**
8. **Individuals with severe allergies and prior anaphylactic reactions should always wear medical alert tags.**

OBJECTIVE 29 **Select true statements concerning the rejection syndrome.**

1. **Is a type of antigen—antibody reaction**
2. **May occur following transplantation of an organ or tissue**
3. **Every organism has a natural tendency to reject foreign substances, especially tissues from another person or animal.**
4. **Tissues or organs to be transplanted are cross-matched in much the same way that blood is matched for transfusion, but matching tissues is more complex than matching blood types.**
5. **Drugs that suppress antibody formation are used to decrease tissue rejection.**

**OBJECTIVE 30**

## Assignment Sheet 1—Determine Human Portals of Entry and Exit for Various Diseases and Infections

Name ______________________ Date ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Portals of entry are correctly identified | ______ |
| • Portals of exit are correctly identified | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

**DIRECTIONS**

Determine how the following diseases and infections are transmitted. First determine how the patient contracted the disease (portal of entry) and then how they could contaminate others (portal of exit).

| | **Portal of Entry** | **Portal of Exit** |
|---|---|---|
| 1. Staphylococcal infection | ______ | ______ |
| 2. Tuberculosis | ______ | ______ |
| 3. Hepatitis A | ______ | ______ |
| 4. Hepatitis B | ______ | ______ |
| 5. Syphilis | ______ | ______ |
| 6. German measles | ______ | ______ |
| 7. Dysentery | ______ | ______ |
| 8. Tetanus | ______ | ______ |
| 9. AIDS (HIV) | ______ | ______ |
| 10. Common cold | ______ | ______ |

**OBJECTIVE 31**

## Assignment Sheet 2—Complete a Personal Immunity Survey

Name ______________________________ Date ______________

---

**Evaluation criteria** **Rating**

- Vaccinations are correctly recorded ______
- Allergies are correctly recorded ______

**Overall rating** ______

Evaluator's comments ______________________________________

______________________________________________________

______________________________________________________

---

**DIRECTIONS**

Complete the following survey indicating the vaccinations you have received and any allergies you may have.

1. Indicate which of the following vaccinations you have received and when you received them.

| | VACCINATION | YES | NO | DATE |
|---|---|---|---|---|
| a. | Smallpox | Y | N | ______ |
| b. | Measles | Y | N | ______ |
| c. | Mumps | Y | N | ______ |
| d. | Rubella | Y | N | ______ |
| e. | Diphtheria | Y | N | ______ |
| f. | Pertussis (whopping cough) | Y | N | ______ |
| g. | Tetanus | Y | N | ______ |
| h. | Polio | Y | N | ______ |
| i. | Influenza | Y | N | ______ |
| j. | Hepatitis B | Y | N | ______ |
| k. | Pneumococcal polysaccharide | Y | N | ______ |
| l. | *Haemophilus* b conjugate (HIB) | Y | N | ______ |
| m. | Cholera | Y | N | ______ |
| n. | Typhoid | Y | N | ______ |

DATE

2. Have you ever had chicken pox? Y N ____________

3. Have you been tested for tuberculosis? Y N ____________

4. Indicate which, if any, of the following items you are allergic to, and describe specifically the item.

Y N Dust, pollen ____________________

Y N Foods ____________________

Y N Drugs, medicines ____________________

Y N Animals, plants ____________________

5. Have you ever had a **severe** (life-threatening) allergic reaction? Y N Describe the cause and what was done to treat the reaction.

____________________

____________________

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6. Has anyone in your family ever had a severe allergic reaction? Y N Explain.

____________________

____________________

____________________

____________________

____________________

OBJECTIVE 32

## Assignment Sheet 3—Practice Critical Thinking: Complete a Case Study on Immunity and Infection

Name ______________________ Date ____________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- Case-study presentation followed agreed-upon format ______
- Case-study presentation met agreed-upon criteria

**Overall rating** ______

Evaluator's comments ______________________________

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INTRODUCTION

In recent years, a great deal has been learned about the body's immune system and the control of infections. Much of this growing knowledge has been a result of the world's need to deal with AIDS. AIDS research has led to a number of discoveries about the immune system and about specific invasions of the body, such as cancer.

This assignment sheet contains four topic areas related to immunity and infection. Your instructor will ask you to research one of those topics.

DIRECTIONS

Check with your instructor to determine which of the following four case studies you will complete. Write the number of that case study on the blank below. Then check with your instructor to determine the format (written report, Power Point presentation, poster, etc.) your instructor wants you to follow in completing your case study. Describe that format on the blanks below. Once you and your instructor have agreed upon the evaluation criteria to be used to evaluate your case-study presentation, write the criteria on the blank lines on the next page. Finally, complete your case study and return it to your instructor for evaluation.

Case-study number ______________________

Format of case-study presentation ______________________

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Evaluation criteria for case-study presentation ______________________________

______________________________________________________

______________________________________________________

______________________________________________________

**Case Study 1**

Acquired immunodeficiency syndrome (AIDS) is the result of a virus that invades the body. One of the earliest indications of AIDS was the occurrence of two conditions that are rarely health issues. One was a cancer known as *Kaposi's carcinoma*. Before 1980, Kaposi's carcinoma was rarely seen and then only as a slow-growing tumor in elderly men. A number of patients were also contracting a particular type of pneumonia that is caused by the protozoan *Pneumocystis carini* (*P. carini*). Humans normally have high resistance to this protozoan and rarely contract this form of pneumonia. Further, the occurrences of Kaposi's carcinoma and *P. Carini* pneumonia seem to be limited to small populations, mostly young homosexual men and injection-drug users in California and New York. Based on these facts, what conclusions can you make regarding the nature of the condition, how it affects the body, and how it spreads? What would be the logical strategy for trying to boost the resistance of the affected population and trying to rid infected persons of the virus? Finally, what precautions would be logical for health-care givers who treat AIDS patients?

**Case Study 2**

A common theory about cancer is that cancerous cells occur in our bodies quite often. According to the theory, however, these cells seldom get established as tumors because the body's immune system normally takes care of the cancerous cells. Unfortunately, there are occasional failures in the immune system that allow cancer cells to become established. At the turn of the last century, a physician named William B. Coley gave cancer patients mixtures of pathogens intended to give them fevers. Many of Coley's patients exhibited remission of their cancers—often at a higher recovery rate than other treatments. Today, some cancers are fought with cytokines such as interferon and interleukin. Much of today's cancer research involves the use of vaccines made from the patient's cancer cells. Based on this information and other facts that you may find, do you think that the immunity deficiency theory for cancer is valid? Why or why not? In keeping with your response, what do you think is the most likely avenue for finding a cure for cancer?

**Case Study 3**

Recently a number of pathogens, such as tuberculosis, no longer are affected by vaccines and other treatments. A number of antibiotics that were once effective against certain pathogens such as streptococcus have little impact. Based on what you learned about the factors that allow a pathogen to cause an infection, what do you think is the reason for this decreased efficiency in drugs and vaccines? How do you think the problem should be addressed?

**Case Study 4**

During recent years, health facilities have made frequent changes in care procedures in order to deal with the increased incidence of AIDS, tuberculosis, and other conditions. Review the precautionary procedures used in your facility, a neighboring facility, or a fictional facility as provided by your instructor. Rate those procedures in how appropriate they are for the following types of patients. Be specific about what you think is proper and how some precautions should be changed.

- An HIV-positive woman delivering a baby
- A patient with chronic tuberculosis requiring surgery for internal injuries following a car accident
- A person with an unknown rash over his entire body who requires a tracheotomy because his throat has swollen shut
- An irrational patient with self-inflicted wounds that require surgical attention

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# Introduction to Surgical Technology

## SECTION C:
## Microbiology

### Module 3-C: Wound Healing

## Module Contents

**COMPONENTS**

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2—Determine Types of Traumatic Wounds . . . 27
3—Distinguish Between Positive and Negative Effects on Wound Healing . . . 29

# Introduction to Surgical Technology
## Section C: Microbiology
## Module 3-C: Wound Healing

**PREREQUISITES:**
**Module 1-C &**
**Module 2-C**

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1.

☐ 5. **Research** Online resources to learn more about wound healing. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Study** Information Sheet, Objective 2 through Objective 5.

☐ 7. **Do** Assignment Sheet 1, "Classify Surgical and Traumatic Wounds."

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, repeat steps 6 and 7.

☐ 9. **Study** Information Sheet, Objective 6.

☐ 10. **Do** Assignment Sheet 2, "Determine Types of Traumatic Wounds."

☐ 11. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 12. If the evaluation is not satisfactory, repeat steps 9 and 10.

☐ 12. **Study** Information Sheet, Objective 7 through Objective 12.

☐ 13. **Do** Assignment Sheet 3, "Distinguish Between Positive and Negative Effects on Wound Healing."

☐ 14. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 15. If the evaluation is not satisfactory, repeat steps 12 and 13.

☐ 15. **Take** Written Test provided by your instructor.

☐ 16. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 17. If the evaluation is not satisfactory, repeat steps 4, 6, 9, and 12.

☐ 17. **Check** With your instructor for any additional assignments to be completed.

☐ 18. **Do** Additional assignments your instructor lists below.

________________________________________

________________________________________

________________________________________

☐ 19. **Take** Module Review provided by your instructor.

☐ 20. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 21. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the assignment sheets, Written Test, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

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## Introduction to Surgical Technology
## Section C: Microbiology
## Module 3-C: Wound Healing

# Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to distinguish among types of wound healing, match types of wounds to their descriptions, and select factors affecting wound healing. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Match the types of injuries that can cause tissue damage to their correct description.
2. Distinguish among the basic types of wounds.
3. Distinguish among types of wound healing.
4. Complete statements concerning the phases of first intention wound healing.
5. Match classes of traumatic wounds to their correct descriptions.
6. Identify types of traumatic wounds.
7. Match classes of surgical (operative) wounds with their correct descriptions.
8. Select factors affecting the wound healing process.
9. Describe factors that present possible complications to the wound-healing process.
10. Complete statements concerning the effects of operative technique on wound healing.
11. Distinguish among types of wound disruption.
12. Complete statements concerning characteristics of wound disruption.
13. Classify surgical and traumatic wounds. (Assignment Sheet 1)
14. Determine types of traumatic wounds. (Assignment Sheet 2)
15. Distinguish between positive and negative effects on wound healing. (Assignment Sheet 3)

# Information Sheet

OBJECTIVE 1

**Match the types of injuries that can cause tissue damage to their correct descriptions.**

1. **Surgical *incision***—The separation of intact tissue by a surgeon using **aseptic** techniques
2. **Traumatic wound**—An injury to living body tissue caused by an **extrinsic** agent

   Examples: Cuts, abrasions, punctures, crushing
3. **Chemical reaction**—An injury to body tissue that is the result of a response of the body to exposure to a chemical

   ✔ **NOTE:** There are a number of reactions to chemicals, both internally and externally. External exposure may lead to chemical burns, rashes, interruptions in chemical processes, and other problems. Internally, chemicals can lead to immediate death from toxin or interference with cell functioning, as with the consumption of alcohol. External chemicals can be absorbed through the skin, eyes, mucous membranes, and other portals of entry to cause internal reactions.
4. **Frostbite**—Local damage to tissue as a result of exposure to low temperatures
5. **Bacterial infection**—The death of cells as a result of the action of microorganisms
6. **Burn**—Damage to tissue due to exposure to a high-energy source

   Examples: Thermal burns, radiation burns, friction burns

KEY TERMS

**Incision**—A smooth-sided wound, especially one made during surgery

**Aseptic**—Free from pathogens

**Extrinsic**—Outside of and not part of (the body)

OBJECTIVE 2

**Distinguish among the basic types of wounds.**

1. **Chronic wounds**—Wounds that will not heal by second intention and may be caused by extrinsic or intrinsic factors

   Examples: Ulcerations, pressure sores, **sinus** tracts
2. **Traumatic injuries**—When a chemical, thermal, or other extrinsic agent has injured living body tissue

3. **Surgical incisions**—When a surgeon cuts through intact tissue using aseptic technique

KEY TERM

**Sinus**—Canal or passage leading to an abscess

**OBJECTIVE 3** **Distinguish among types of wound healing.**

1. **Healing by first intention**

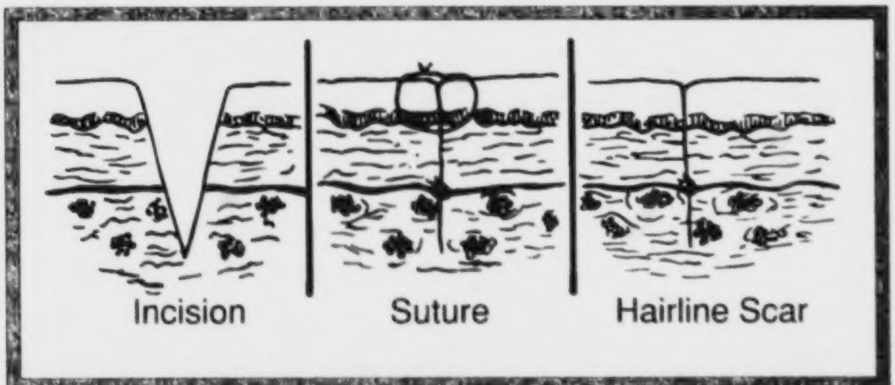

**Figure 1**
First Intention

- Has no **postoperative** swelling.
- Has no serous discharge or local infection.
- Has no separation of wound edges and minimal **scar** formation ("hair line" scar).
- Healing is by **primary union**. The wound is closed with a **suture** soon after the incision or **trauma**.
- Healing is relatively fast.

### KEY TERMS

**Postoperative**—Following a surgical procedure

**Scar**—A mark left on the skin as a result of an injury

✔ **NOTE:** A *cicatrix* is a scar left by a healed wound.

**Primary union**—The situation in which severed tissue is essentially reunited with the tissue from which it was originally separated and that the healing process begins without disruptions from swelling, contamination, infection, and other factors.

✔ **NOTE:** *Adhesion* is the union of two surfaces or structures that normally are separate.

**Suture**—A stitch placed in tissue to hold the sides of a wound together during the healing process

**Trauma**—Injury to body tissue produced by violence or any chemical, thermal, or other extrinsic agent

### 2. Healing by second intention

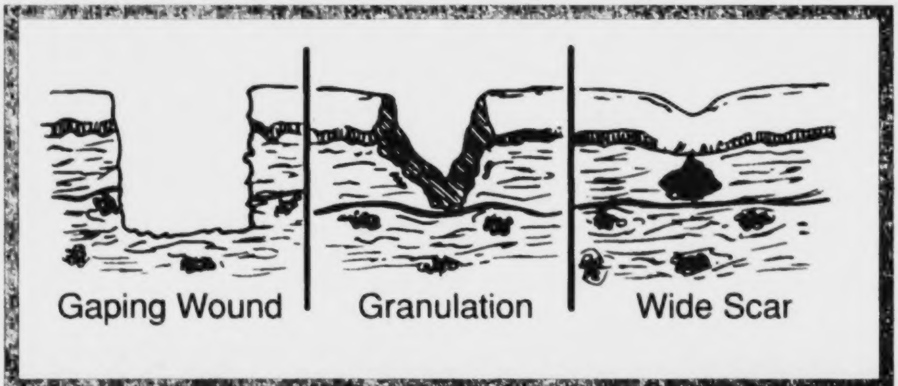

**Figure 2**
Second Intention

- Infection, excessive trauma, loss of tissue, or poorly **approximated** tissue is present.
- Healing is by process of **granulation** from the bottom up.
- Wound is NOT closed (sutured).
- Granulation tissue forms in the gap of the wound and closes it by contraction.
- Healing takes longer than first intention (because more area must be filled in).
- Scar formation is excessive.

- Healing may produce a weak union, which may be conducive to incisional herniation (rupture) later.
- Risk of a secondary infection is proportional to amount of necrotic tissue present.
- There is serous discharge.
- There is excessive separation of the wound edges.

3. **Healing by third intention**

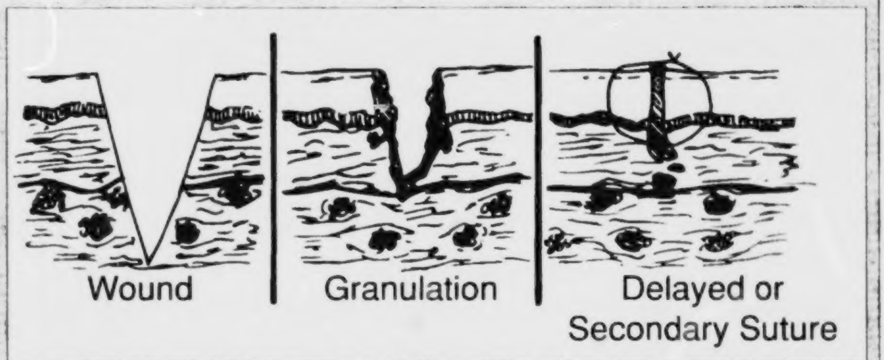

**Figure 3**
Third Intention

- Similar to second intention healing except wound is sutured, either delayed or secondary.
  - When wound is infected at time of surgery, suturing is delayed until infection subsides.

    Example: **Debridement** of third degree burn
  - When a sutured wound becomes very infected after surgery, the primary sutures are removed and secondary sutures are put in later after infection subsides.
  - During this period of waiting for infection to subside, wound has begun to heal by granulation, and now the two surfaces of granulation tissue are brought together by the delayed or secondary sutures.
- Healing takes longer than first intention.
- A deeper and wider scar usually results.
- Healing may produce a weak union, which may be conducive to incisional herniation later.
- There may be loss of tissue due to infections or complications of the healing process.
- There is serous discharge.

- There is excessive separation of the wound edges due to **disruption** of the healing process.

KEY TERMS

**Approximate**—To bring two tissue surfaces close together, as in the repair of a wound

**Granulation**—Formation of new tissue, composed largely of newly growing capillaries which form in types of wounds left open; any soft, pink, fleshy projections that form during the healing process in a wound not healing by first intention

✓ **NOTE:** Granulation tissue consists of many capillaries surrounded by fibrous collagen. It is not visible in first intention healing. The overgrowth of granulation tissue is referred to as *proud flesh*.

**Debridement**—Removal of foreign materials; cutting away all dead and devitalized tissues leaving an open, clean wound where anaerobic organisms cannot survive

**Disruption**—When the orderly closure of a wound is altered; usually suture lines break down, decreasing support of abdominal wall over peritoneal contents

**Keloid**—Dense, unsightly connective tissue or excessive scar formation that is often removed surgically

OBJECTIVE 4

**Complete statements concerning the phases of first intention wound healing (no infection).**

1. **Lag (substrate) phase (days 1–6)**
   - Exudate containing blood, lymph, and **fibrin** begins clotting and loosely binds the cut edges together.
   - Fibrin, clotting blood, and serum protein dry out, forming a scab which seals the wound.
   - **Leukocytes** remove bacteria and damaged tissue debris.
2. **Healing (proliferative) phase (days 6–14)**
   - **Fibroblasts** multiply rapidly bridging wound edges, and secrete **collagen** which forms fibers.
   - **Tensile strength** grows rapidly because of collagen.
   - New cells are formed.
3. **Maturation (remodeling) phase (days 14–21)**
   - Scar forms.

- Collagen reforms into cross-links which increase tensile strength.
- As collagen density increases, vascularity decreases, and the scar grows pale.

KEY TERMS

**Leukocyte**—Another term for a white blood cell

**Fibrin**—A stringy, insoluble protein produced in the clotting process

✔ **NOTE:** *Fibrinogen* is a protein produced by the liver that is converted into fibrin by thrombin to promote clotting at an injury site; aids in coagulation

**Fibroblast**—A connective tissue cell that produces collagen and elastin fibers

**Collagen**—White protein contained in connective tissues and bones

**Tensile strength**—A material's resistance to being torn apart by opposing forces

OBJECTIVE 5

**Match classes of traumatic wounds to their correct descriptions.**

1. **Closed wounds**—The skin is intact, but the underlying tissue is injured.

   Examples: Simple fractures, torn ligaments, blister

2. **Open wounds**—The skin is broken.

   Examples: Abrasions, lacerations, penetrations

   - **Simple**—The skin is interrupted but without loss or destruction of underlying tissue

     Example: Lacerations

   - **Complicated**—The skin and underlying tissues are injured or destroyed by crushing, burning, or implantation of a foreign object.

     Example: Bullet or sharp object that is still present

   - **Clean**—The object and/or conditions surrounding the injury were relatively clean. The wound is cared for within six hours after it occurs. Will heal by first intention.

     Example: Cut occurs when unloading dishwasher

   - **Contaminated**—The conditions and/or object surrounding the injury are obviously not clean; or if the wound is over six hours old. Will heal by second or third intention.

     Example: Cut occurs in a livestock holding pen

**OBJECTIVE 6** **Identify types of traumatic wounds.**

1. **Abrasion**—A wound caused by mechanical irritation such as boot rubbing, scraping, or being injured with sandpaper

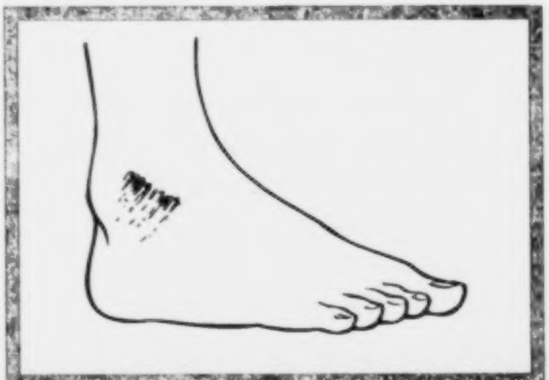

Figure 4
Abrasion

2. **Avulsion**—A portion of the skin and soft tissue is partially or completely torn away

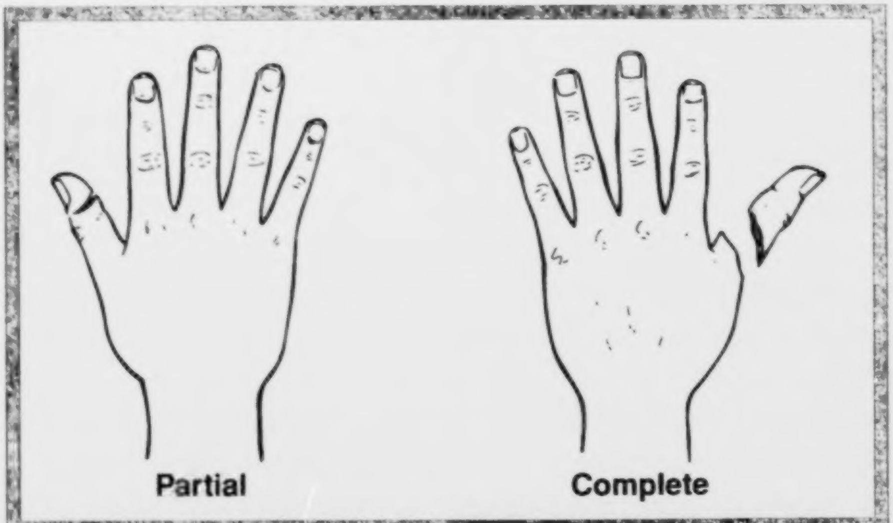

Figure 5
Avulsion

3. **Contusion**—A bruise that may be caused by a blunt instrument in which skin is not broken, the tissues below the surface are damaged, and the blood vessels have ruptured causing discoloration

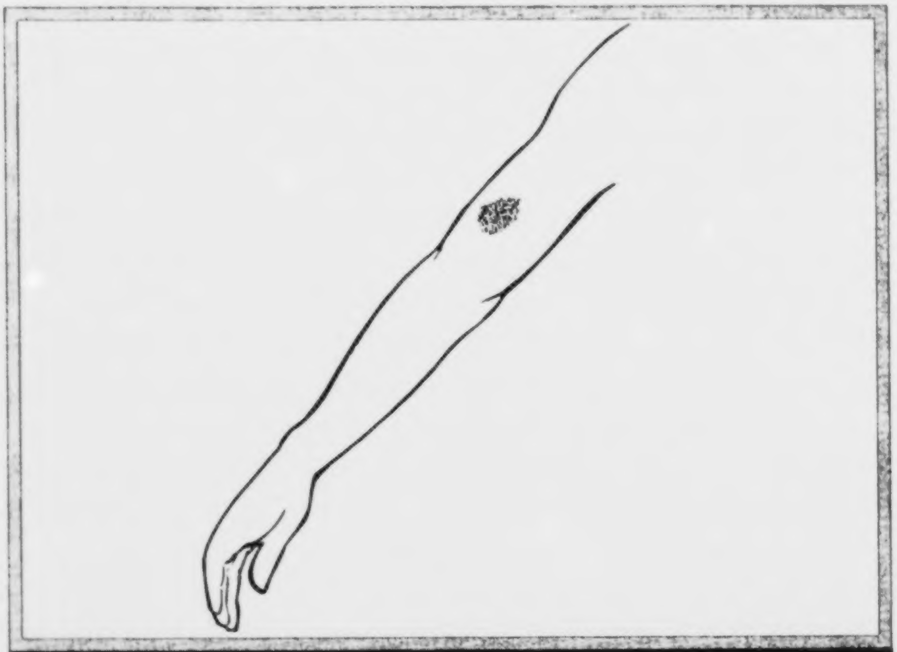

**Figure 6**
Contusion

4. **Crushed**—A wound that has been squeezed or forced by pressure so as to alter or destroy the tissue structure

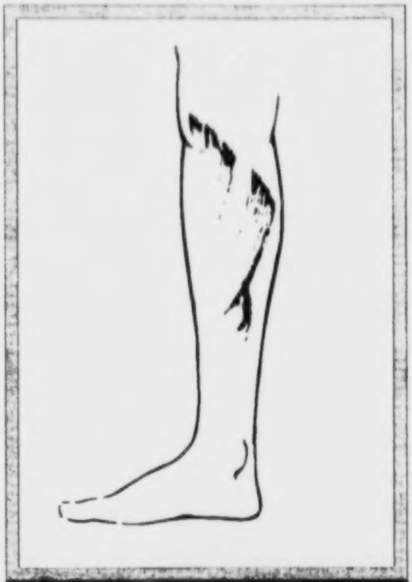

Figure 7
Crushed

5. **Incised**—A wound with smooth edges that is made by a cutting instrument; may be contaminated (cut with ordinary glass) or clean (cut by knife in surgery)

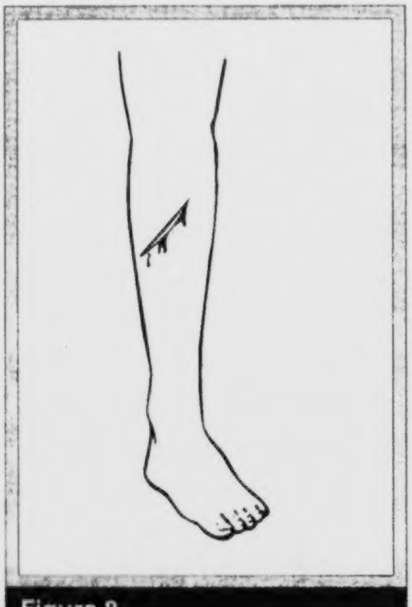

Figure 8
Incised

6. **Laceration**—A torn wound with irregular edges

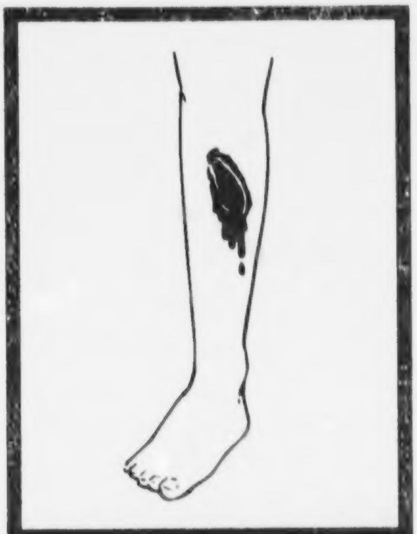

Figure 9
Laceration

7. **Puncture**—A wound made by a sharp, pointed instrument

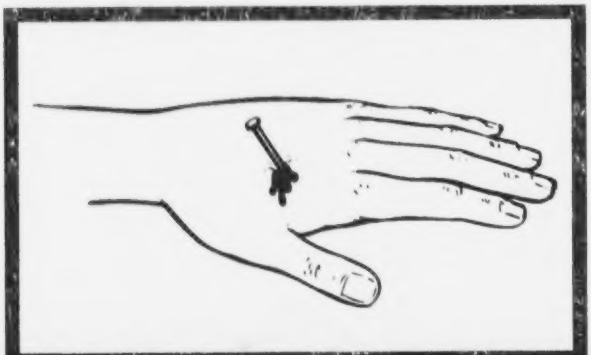

Figure 10
Puncture

8. **Perforation**—A wound in which the vulnerating body (such as bullet) both enters and emerges from the cavity

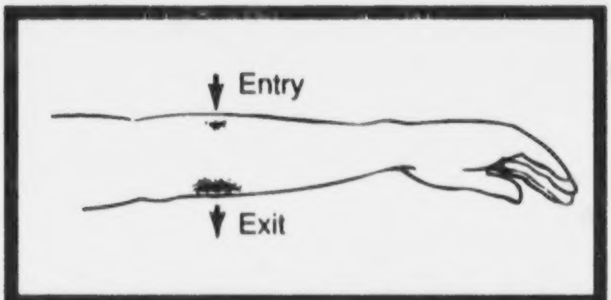

Figure 11
Perforation

OBJECTIVE 7 **Match classifications of surgical (operative) wounds (AORN) with their correct descriptions.**

✔ **NOTE:** At the end of the surgical procedure the circulating nurse records the wound classification in the operative record.

1. **Clean wound** (expected infection rate: 1% to 5%)
   - Elective procedure; wound made under ideal conditions
   - Primary closure, no drain
   - No breaks in aseptic technique
   - No inflammation present
   - Alimentary, genitourinary, or respiratory tracts or oropharyngeal cavity not entered
2. **Clean-contaminated wound** (expected infection rate: 8% to 11%)
   - Primary closure, wound drained
   - Minor breaks in aseptic technique occurred
   - No inflammation present
   - Alimentary, genitourinary, or respiratory tract or oropharyngeal cavity entered under controlled conditions—without unusual contamination or spillage

   ✔ **NOTE:** This includes hysterectomies, transection of appendix or cholecystic duct in the absence of acute inflammation, and entrance into genitourinary or biliary tracts in the absence of infected bile or urine.

3. **Contaminated wound** (expected infection rate: 15% to 20%)
   - Open fresh traumatic wound of less than four hours old
   - Major break in aseptic technique occurred
   - Acute, nonpurulent inflammation present
   - Gross spillage/contamination from gastrointestinal tract
   - Entry into biliary or genitourinary tracts with infected bile or urine present
4. **Dirty and infected wound** (expected infection rate: 27% to 40%)
   - Old traumatic wound of over four hours old from a dirty source or the presence of necrotic tissue, foreign body, or fecal material
   - Microbial contamination is present in the operative field before the procedure
   - Acute bacterial inflammation is present; may be **purulent** or there is a known clinical infection
   - Presence of a perforated organ such as a bowel

KEY TERM

**Purulent**—Containing pus

OBJECTIVE 8

**Select factors affecting the wound healing process.**

1. **Age, weight, and general health**
   - Skin tone and muscle tone decrease with age.
   - Excess fat causes difficulty in confining and securing good closure, and is the most vulnerable of all tissues to trauma and infection.
   - Associated diseases such as diabetes, anemia, cirrhosis, and leukemia can delay the wound-healing process. Malignancies, debilitating injuries, and systemic or localized infections can also adversely affect wound healing.
   - The body's ability to heal declines as a person ages.

   ✔ **NOTE:** A number of conditions brought on by age interfere with the healing process. Tissue vitality decreases with age. Organs involved in the healing process may not be functioning at their full capacity. For example, an age-weakened heart and clogged arteries reduce the flow of blood to the wound site, while an elderly person's digestive system may not efficiently process the nutrients required for healing. The immune system may become less able to fend off infection with increased age.

2. **Nutritional status**—The production of cells and tissues as part of the healing process requires an adequate supply of the proper nutrients.
   - Wound healing is impaired by deficiencies in zinc, protein, carbohydrates, and vitamins A, B, and C.
   - Protein provides essential amino acids for new tissue construction.
   - Vitamin C permits collagen formation and also aids in the production of connective tissue and a strong scar.
   - Carbohydrates are necessary for healing.
   - Vitamin B is necessary for carbohydrate metabolism.
3. **Fluid and electrolyte balance**—Changes in this balance can affect kidney function, cellular metabolism, oxygen concentration in circulation, or hormonal function
   - The transport to the wound site of nutrients, oxygen, hormones, and other substances that promote healing depends on the pathways provided by blood and interstitial fluids.
4. **Immune response**
   - Normal immune response speeds tissue healing.
   - Abnormalities in immune response such as allergic reactions can contribute to delayed wound healing.
   - Immunosuppressed/compromised host—Lack of a functioning immune system can be life threatening.
5. **Drug therapy**—Since wound healing is basically collagen synthesis, any agents that interfere with cellular metabolism such as steroids have a potentially deleterious effect on the healing process.
6. **Radiation therapy**
   - Healing is delayed if the patient has had radiation in large doses preoperatively.
   - The blood supply in irradiated tissue is decreased; however, little change from the normal healing pattern occurs if radiation has been given in low doses.
7. **Postoperative complications**
   - Edema, vomiting, or coughing can place stress on the healing wound before fibroplasia takes place.
   - Complications in other parts of the body, far from the site of operation, such as pneumonia or thrombus or embolus formation, can inhibit oxygen supply to the wound site.
8. **Physical activity**—Early ambulation speeds up circulation and decreases post operative complications.

9. **Surgical technique**—Good surgical technique complements the body's healing functions while poor surgical technique interferes with the healing process.

   ✔ **NOTE:** Poor antiseptic practices can lead to infections, while improperly performed incisions or suturing can lead to a poorly closed wound, tearing of sutures, or herniation. Healing is promoted when the depth and the size of the incision are kept to a minimum. The use of correct wound-closure technique can ensure that the tissue fuses well and has minimal scarring.

10. **Complications**—Outside influences not directly related to the surgery can interfere with wound healing.

    ✔ **NOTE:** Conditions that stress the suture, such as coughing or nausea, and infections unrelated to the primary site can slow the healing process. Some patients may have additional injuries or illnesses that divert healing resources from the surgical wound site.

11. **Exercise**—The improved circulation that comes with exercise helps to deliver oxygen, nutrients, and other resources required for healing to the wound.

    ✔ **NOTE:** While exercise is helpful, it should be appropriate to the patient's condition and surgery so that the sutures are not stressed.

12. **Infection**—The fighting of an infection reduces the amount of nutrients, oxygen, and other substances that can be involved in the healing process; further, the pathogens may produce toxins that interfere with the body's chemicals that are involved in healing.

    ✔ **NOTE:** Tissues that are combating infection are slow to heal because the infection interferes with the healing process. The body's resources may be diverted away from the healing process to fight the infecting pathogens.

OBJECTIVE 9

**Describe factors that present possible complications to the wound-healing process.**

1. **Hemorrhage**—The loss of a large amount of blood in a short time caused by a failure of open blood vessels to adequately clot or to remain sealed

   ✔ **NOTE:** Clotting is an important part of the healing process because it helps to seal the wound. However, conditions such as hemophilia and anemia may prevent the blood from clotting properly. The loss of blood that results from hemorrhaging also reduces the amount of oxygen and nutrients that are available to the injured area and that are needed to promote healing.

2. **Sinus-tract formation**—The development of channels that permit the escape of purulent materials from pockets of pus and other fluids

   ✔ **NOTE:** Pockets of pus harbor the potential for infections to develop, and sinus tracts keep tissues separated that must be knit together during the healing process.

3. **Hematoma**—A swelling or tumor that contains blood that is generally clotted

   ✔ **NOTE:** A hematoma is similar to a sinus tract in that it creates a physical separation between tissue that must grow together. Hematomas also represent an area of reduced blood circulation that slows the healing process.

4. **Infection**—The presence of pathogens in a wound site

   ✔ **NOTE:** Infecting pathogens rob a wound site of nutrition and interfere with the normal functioning of cells. This interference may include disruption of the chemical processes involved in healing and reduction of the reproductive activities of the cells that are required to replace dead cells.

5. **Herniation**—A protrusion of an organ or tissue structure into a wound site

   ✔ **NOTE:** Herniation can lead to a number of complications. Like hematomas and sinus tracts, a protruding organ can force its way between tissue layers that are trying to rejoin. The pressure of the hernia can restrict blood flow, thus delaying the healing process. The hernia itself may lead to the development of other conditions, including infections, that reduce the healing resources that are available to the primary site. Depending on the organ involved, herniation may prevent the normal functioning of organs that support the healing process. For example, a herniated bowel may reduce the efficiency of digestion, a process that is vital in supplying nutrients to the body. Without proper digestion of food, proteins and vitamins that are necessary to build new cells may not enter the blood supply.

6. **Wound disruption**—One of the conditions—dehiscence, evisceration, or eventration—that interrupts the wound-healing process.

   ✔ **NOTE:** Wound disruption is one of various conditions that can occur to the post-surgical patient. Generally, dehiscence, evisceration, and eventration are the result of a patient's not following postoperative-care instructions, causing the sutures to tear or the displacement of organs due to weakened tissues. (See Objective 11 for more information on these three conditions.) Occasionally, wound disruption occurs due to poor surgical technique. Disruption usually occurs between the fourth and sixth postoperative day.

OBJECTIVE 10

**Complete statements concerning the effects of operative technique on wound healing.**

1. **Aseptic technique**—Must be followed by all of the operating room team to promote healing and prevent infection.

2. **Hemostasis**—Must be achieved to prevent loss of the patient's blood and to provide as bloodless a field as possible for accurate dissection, and to prevent hematoma formation.

3. **Tissue handling**

   - All tissues should be handled as gently and as little as possible throughout the procedure.
   - Incisions should be just long enough to afford sufficient operating space.
   - Laparoscopes are used more frequently because they minimize tissue trauma (only require a puncture) and speed healing.
   - Careful consideration is given to underlying blood vessels and nerves to preserve as many as possible.

- Retractors are placed to provide exposure but without causing undue pressure on tissues and organs or tension on muscles.

✔ **NOTE:** Trauma to tissues in dissecting, handling with instruments, ligating, or suturing may cause edema and **necrosis** with resultant slow healing.

KEY TERM

**Necrosis**—Death of tissue cells

4. **Tissue approximation**

- Tissue edges are brought together with precision, avoiding strangulation and eliminating dead space, to promote wound healing.
- Too tight a closure under tension causes **ischemia**.
- Serum or blood may collect in a dead space and prevent healing by keeping the cut edges of tissue separated.
- Wound edges not in close contact cannot heal readily.
- A drain may be inserted to aid in removal of fluid or air from the operative site postoperatively or a pressure dressing may be applied over the closed wound to help obliterate dead space.

KEY TERM

**Ischemia**—Decrease of blood supply to the tissue

5. **Wound closure**

- Drainage tubes may cause a weak spot in the incision; or provide an inlet for microorganisms as well as an outlet for drainage; therefore, drains may be placed through a stab wound in the skin rather than through the operative incision.
- When sutures are used, the suture material provides all of the strength of the wound immediately after closure.
- Closely spaced sutures give a stronger suture line.
- The strength of a suture should not be greater than the strength of the tissue on which it is used.
- To minimize tissue reaction to sutures, the least amount and smallest size suture consistent with the holding power of the tissue is used.

**OBJECTIVE 11**

**Distinguish among types of wound disruption.**

1. **Dehiscence**—Separation of the layers of a surgical wound
2. **Evisceration**—Extrusion of internal organs or viscera resulting from wound dehiscence. A portion of the wound may remain closed.
3. **Eventration**—Partial protrusion of the abdominal contents through an opening in the abdominal wall

**OBJECTIVE 12**

**Complete statements concerning characteristics of wound disruption.**

1. **May occur in a small percentage of clean, surgical, abdominal wounds**
2. **Usually happens between 4th and 6th postoperative day**
3. **Symptoms**
   - Patient may feel something give way.
   - There may be a profuse amount of **sero-sanguinous** drainage on abdominal dressing.
   - Contour of abdomen may change with marked bulging or actual spilling out of abdominal organs through incision.
4. **Causes**
   - Infection
   - Abdominal distention
   - Type and direction of incision
   - Nutritional status of patient
   - Coughing, straining, unusual activity
   - Diseases

KEY TERM

**Sero-sanguinous**—Blood-tinged or colored serous drainage

## Introduction to Surgical Technology
## Section C: Microbiology
## Module 3-C: Wound Healing

**OBJECTIVE 13**

# Assignment Sheet 1—Classify Surgical and Traumatic Wounds

Name ______________________________ Date ________________

**Evaluation criteria** **Rating**

- Surgical wounds are correctly classified ________
- Traumatic wounds are correctly classified ________

**Overall rating** ________

Evaluator's comments ______________________________

______________________________

______________________________

**DIRECTIONS**

Read the scenarios, and then classify the type of wound as one of the following:

| Classes of Surgical Wounds | Classes of Traumatic Wounds |
|---|---|
| Clean | Simple, clean |
| Clean-contaminated | Simple, contaminated |
| Contaminated | Complicated, clean |
| Dirty and infected | Complicated, contaminated |

**Part I—Classes of Surgical Wounds**

________________ 1. A man was operated on for a perforated bowel. During surgery, there was considerable inflammation and fecal material present.

________________ 2. A woman had a hysterectomy. Acute inflammation was not present.

________________ 3. A young teenager's appendix ruptured and was then removed. Acute, purulent infection was present.

________________ 4. A man had a face-lift. There were no breaks in aseptic technique.

________________ 5. A woman had a cholecystectomy. Acute, non-purulent inflammation and infected bile were present.

### Part II—Classes of Traumatic Wounds

____________________ 6. Woman fractured her ribs, and the skin was broken.

____________________ 7. Boy scraped his knee on the sidewalk pavement.

____________________ 8. Man cut his finger on a sharp, clean table.

____________________ 9. Older woman's leg wound from a dog bite failed to heal and required full thickness skin grafting.

____________________ 10. Male plumber lacerated his hand with the tool used to clean out a sewer pipe.

**OBJECTIVE 14**

## Assignment Sheet 2—Determine Types of Traumatic Wounds

Name ______________________ Date ______________

**Evaluation criterion** **Rating**

- Traumatic wounds are correctly identified according to type ______

**Overall rating** ______

Evaluator's comments ______________________________________

**DIRECTIONS**

Read the following descriptions, and then determine which one of the following types they are:

**Types of Traumatic Wounds**

Abrasion
Avulsion, partial or complete
Contusion
Crushed
Incised
Laceration
Puncture
Perforation

______________ 1. A bullet enters a woman's right arm, front side, and exits the back side of the arm.

______________ 2. While moving, a piano is dropped on a man's leg resulting in a fracture, soft tissue damage, and torn skin.

______________ 3. A woman catches her hand in the lawn mower blades, and a finger is almost totally cut off.

______________ 4. A man steps on a tack.

______________ 5. A young girl is cut by a razor blade.

______________ 6. A boy is cut by a jagged piece of metal.

______________ 7. A girl scrapes her leg sliding into home base.

______________ 8. A man is hit with a baseball. A bruise occurs.

**OBJECTIVE 15**

## Assignment Sheet 3—Distinguish Between Positive and Negative Effects on Wound Healing

Name ______________________________ Date ______________

---

**Evaluation criteria** **Rating**

- Patient conditions are correctly identified as positive or negative effects on healing ______
- Operative techniques are correctly identified as positive or negative effects on healing ______

**Overall rating** ______

Evaluator's comments ______________________________

______________________________

______________________________

---

**DIRECTIONS**

Identify the following patient conditions and operative techniques as having positive (P) or negative (N) effects on healing.

**Patient Conditions**

______ 1. Decreased muscle tone
______ 2. Excessive fatty tissue
______ 3. Good muscle tone
______ 4. Good health, no disease process present
______ 5. Vitamins A, B, and C are being consumed
______ 6. Diet is high in fat and low in carbohydrates
______ 7. Diet contains no protein (amino acids)
______ 8. Adequate fluids are being consumed and electrolytes are in balance
______ 9. Immune responses are normal
______ 10. Immunosuppressant drugs are being taken
______ 11. Tissue presently being treated with radiation therapy
______ 12. Evidence of postoperative swelling
______ 13. Early ambulation
______ 14. Evidence of postoperative thrombus formation

### Operative Techniques

_______15. Strict aseptic technique

_______16. Lack of hemostasis

_______17. Tissue handled very gently and as little as possible

_______18. Adequate, but minimal, length of incision

_______19. Careful placement of retractors

_______20. Leaving undrained dead spaces

_______21. Precise wound closure that avoids strangulation

_______22. Loose wound closure, leaving a space between wound edges

_______23. Sutures are very tight and far apart

_______24. Draining a dead space through a separate stab incision

_______25. Draining a dead space with drain directly in wound

_______26. Using the least amount and smallest size of suture consistent with the holding power of the tissues

# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

### Module 1-D: Basic Math

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# Introduction to Surgical Technology
# Section D: Pharmacology
# Module 1-D: Basic Math

**PREREQUISITES:** None

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 4.

☐ 5. **Do** Assignment Sheet 1, "Add Whole Numbers."

☐ 6. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 7. If the evaluation is not satisfactory, repeat step 5.

☐ 7. **Study** Information Sheet, Objective 5.

☐ 8. **Do** Assignment Sheet 2, "Subtract Whole Numbers."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat step 8.

☐ 10. **Study** Information Sheet, Objective 6.

☐ 11. **Do** Assignment Sheet 3, "Multiply Whole Numbers."

☐ 12. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat step 11.

☐ 13. **Study** Information Sheet, Objective 7.

☐ 14. **Do** Assignment Sheet 4, "Divide Whole Numbers."

☐ 15. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 16. If the evaluation is not satisfactory, repeat step 14.

☐ 16. **Study** Information Sheet, Objective 8 and Objective 9.

☐ 17. **Do** Assignment Sheet 5, "Reduce Fractions to Lowest Terms."

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☐ 18. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 19. If the evaluation is not satisfactory, repeat step 17.

☐ 19. **Study** Information Sheet, Objective 10.

☐ 20. **Do** Assignment Sheet 6, "Convert Fractions to Mixed Numbers."

☐ 21. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 22. If the evaluation is not satisfactory, repeat step 20.

☐ 22. **Study** Information Sheet, Objective 11.

☐ 23. **Do** Assignment Sheet 7, "Add Fractions."

☐ 24. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 25. If the evaluation is not satisfactory, repeat step 23.

☐ 25. **Study** Information Sheet, Objective 12.

☐ 26. **Do** Assignment Sheet 8, "Subtract Fractions."

☐ 27. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 28. If the evaluation is not satisfactory, repeat step 26.

☐ 28. **Study** Information Sheet, Objective 13.

☐ 29. **Do** Assignment Sheet 9, "Multiply Fractions."

☐ 30. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 31. If the evaluation is not satisfactory, repeat step 29.

☐ 31. **Study** Information Sheet, Objectives 14 and 15.

☐ 32. **Do** Assignment Sheet 10, "Add Decimal Numbers."

☐ 33. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 34. If the evaluation is not satisfactory, repeat step 32.

☐ 34. **Study** Information Sheet, Objective 16.

☐ 35. **Do** Assignment Sheet 11, "Subtract Decimal Numbers."

☐ 36. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 37. If the evaluation is not satisfactory, repeat step 35.

☐ 37. **Study** Information Sheet, Objective 17.

☐ 38. **Do** Assignment Sheet 12, "Multiply Decimal Numbers."

☐ 39. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 40. If the evaluation is not satisfactory, repeat step 38.

☐ 40. **Study** Information Sheet, Objective 18.

☐ 41. **Do** Assignment Sheet 13, "Divide Decimal Numbers."

☐ 42. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 43. If the evaluation is not satisfactory, repeat step 41.

☐ 43. **Study** Information Sheet, Objective 19.

☐ 44. **Do** Assignment Sheet 14, "Convert Fractions and Percentages."

☐ 45. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 46. If the evaluation is not satisfactory, repeat step 44.

☐ 46. **Study** Information Sheet, Objective 20.

☐ 47. **Do** Assignment Sheet 15, "Solve Percentage Problems."

☐ 48. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 49. If the evaluation is not satisfactory, repeat step 47.

☐ 49. **Study** Information Sheet, Objective 21.

☐ 50. **Do** Assignment Sheet 16, "Convert Roman Numerals to Arabic Numerals."

☐ 51. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 52. If the evaluation is not satisfactory, repeat step 49.

☐ 52. **Do** Assignment Sheet 17, "Read a U.S. Customary Rule."

☐ 53. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 54. If the evaluation is not satisfactory, repeat step 52.

☐ 54. **Take** Written Test provided by your instructor.

☐ 55. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 56. If the evaluation is not satisfactory, repeat steps 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, and 49.

☐ 56. **Check** With your instructor for any additional assignments to be completed.

☐ 57. **Do** Additional assignments your instructor lists below.

______________________________

______________________________

______________________________

☐ 58. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test and assignment sheets. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to solve basic math problems and read a U.S. Customary rule. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Match terms associated with math and measuring to their correct definitions.
2. Match symbols used in basic math with their names.
3. Label the place values of a whole number.
4. Add whole numbers to solve problems.
5. Subtract whole numbers to solve problems.
6. Multiply whole numbers to solve problems.
7. Divide whole numbers to solve problems.
8. Distinguish among types of fractions.
9. Reduce fractions to lowest terms.
10. Convert fractions and mixed numbers.
11. Add fractions to solve problems.
12. Subtract fractions to solve problems.
13. Multiply fractions to solve problems.
14. Label place values in a decimal number.
15. Add decimal numbers to solve problems.
16. Subtract decimal numbers to solve problems.
17. Multiply decimal numbers to solve problems.
18. Divide decimal numbers to solve problems.
19. Convert fractions and percentages.
20. Solve percentage problems.
21. Convert Roman numerals to Arabic numerals.
22. Add whole numbers. (Assignment Sheet 1)

23. Subtract whole numbers. (Assignment Sheet 2)
24. Multiply whole numbers. (Assignment Sheet 3)
25. Divide whole numbers. (Assignment Sheet 4)
26. Reduce fractions to lowest terms. (Assignment Sheet 5)
27. Convert fractions to mixed numbers. (Assignment Sheet 6)
28. Add fractions. (Assignment Sheet 7)
29. Subtract fractions. (Assignment Sheet 8)
30. Multiply fractions. (Assignment Sheet 9)
31. Add decimal numbers. (Assignment Sheet 10)
32. Subtract decimal numbers. (Assignment Sheet 11)
33. Multiply decimal numbers. (Assignment Sheet 12)
34. Divide decimal numbers. (Assignment Sheet 13)
35. Convert fractions and percentages. (Assignment Sheet 14)
36. Solve percentage problems. (Assignment Sheet 15)
37. Convert Roman numerals to Arabic numerals. (Assignment Sheet 16)
38. Read a U.S. customary rule. (Assignment Sheet 17)

## Information Sheet

**OBJECTIVE 1** **Match terms and definitions associated with math and measuring to their correct definitions.**

1. **Whole number (integer)**—Any of the natural numbers, both positive and negative, that represents a complete item

   Example: 25 is a whole number as opposed to 3/4, a fraction or part of a whole.

2. **Digit**—Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

3. **Fraction**—Part of a whole; represents one or more equal parts of a unit

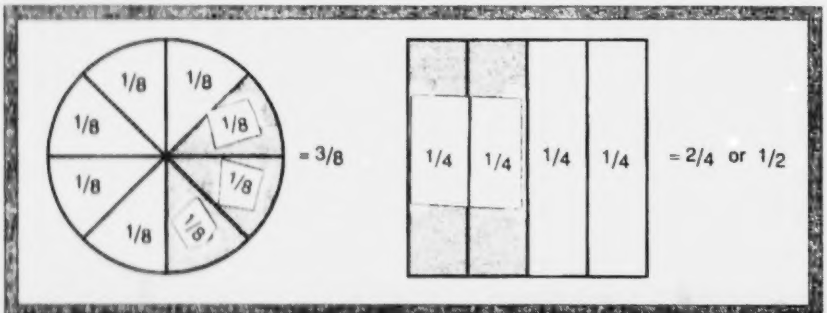

Figure 1—Fraction (part of a whole)
Represents one or more equal parts of a unit

4. **Decimal**—Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

   Examples: 0.1 = 1/10 0.06 = 6/100 0.003 = 3/1000

5. **Addition**—Process of totaling two or more numbers to find another number called a sum

   Examples: 3 + 5 + 9 = 17

6. **Subtraction**—Opposite operation of addition

   Examples: 8 – 4 = 4 as opposed to 4 + 4 = 8

7. **Multiplication**—Abbreviated process of adding a number to itself a specified number of times

   Examples: 6 x 3 = 18 as opposed to 6 + 6 + 6 = 18

8. **Division**—Opposite operation of multiplication

   Example: 16 ÷ 2 = 8 as opposed to 8 x 2 = 16

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9. **Percent**—One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

10. **Ratio**—Relationship in quantity, amount, or size between two or more things

11. **Proportional**—Being relatively equal in size or quantity

    Example: 1:1:3 = 0.5:0.5:1.5

12. **Meter**—Metric unit used to measure length

13. **Liter**—Metric unit used to measure capacity

OBJECTIVE 2 **Match symbols used in basic math with their names.**

| | |
|---|---|
| Plus sign (addition) | + |
| Minus sign (subtraction) | – |
| Times sign (multiplication) | X |
| Division sign | ÷ |
| Division frame | ⟌ |
| Equal sign | = |
| Decimal point | . |
| Percent symbol | % |
| Ratio symbol | : |

**Objective 3** **Label the values of a whole number.**

✔ **NOTE:** The position of a digit in a number shows how much that digit is worth. These positions are called *place values*.

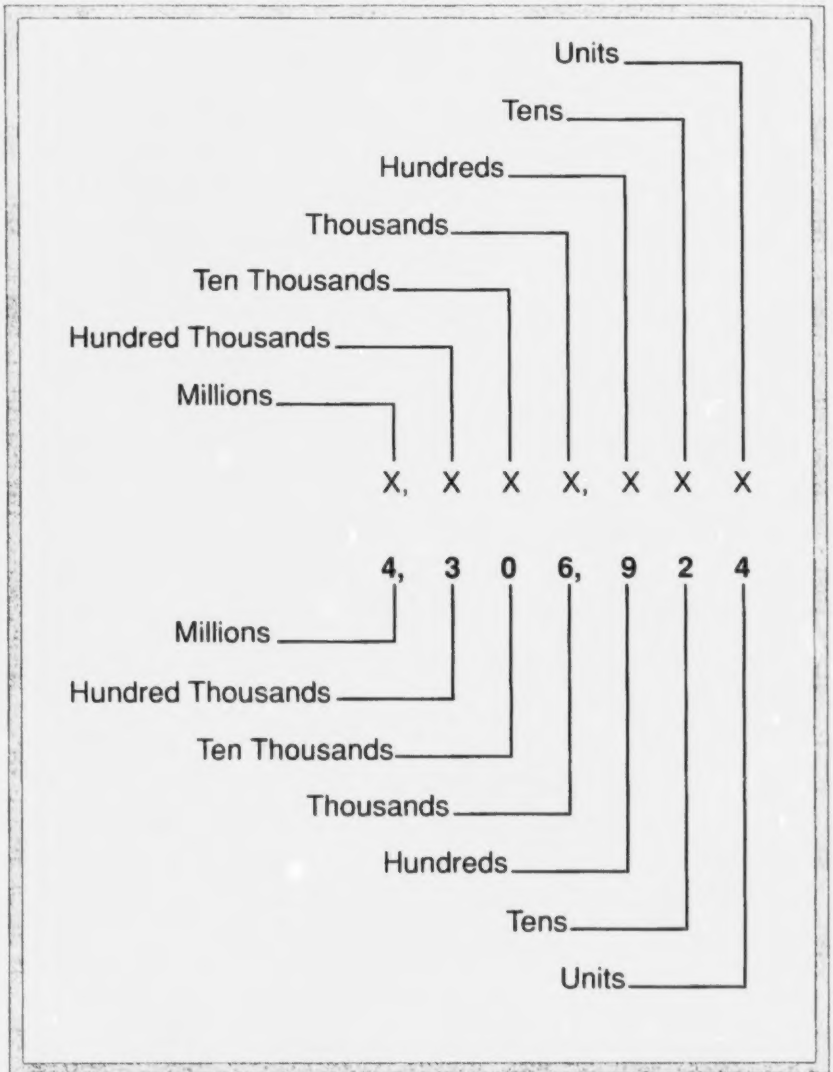

Units
Tens
Hundreds
Thousands
Ten Thousands
Hundred Thousands
Millions
X, X X X, X X X
4, 3 0 6, 9 2 4
Millions
Hundred Thousands
Ten Thousands
Thousands
Hundreds
Tens
Units

Figure 2—Whole number

✔ **NOTE:** The number in this example is four million, three hundred six thousand, nine hundred twenty-four.

**OBJECTIVE 4** **Add whole numbers to solve problems.**

1. **Set up problem by writing units under units, tens under tens, and so on.**

Example: Add whole number 1632, 17, 550.

$$\begin{array}{r} 1632 \\ 17 \\ \underline{+\,550} \end{array}$$

2. **Add each column separately, beginning at top of units column.**

Example:

$$\begin{array}{rcr} 1632 & \quad & 1632 \\ 17 & & 17 \\ \underline{+\,550} & & \underline{+\,550} \\ 9 & & 99 \end{array}$$

3. **If the sum of any column is two or more digits, write the units digit in your answer and carry the remaining digit(s) to the top of next column to the left.**

Example:

$$\begin{array}{lrr} & \mathbf{1} \longleftarrow & \text{Carry remaining digit.} \\ & 1632 & 1632 \\ & 17 & 17 \\ \text{Write units} & \underline{+\,550} & \underline{+\,550} \\ \text{digit} \longrightarrow & 199 & 199 \end{array}$$

4. **Add any carried digit(s) above the column with that column.**

Example:

$$\begin{array}{rl} 1 \phantom{000} & \text{Carried Digit} \\ 1632 & \\ 17 & \\ \underline{+\,550} & \\ 2199 & \end{array}$$

**OBJECTIVE 5** **Subtract whole numbers to solve problems.**

1. **Set up problem by writing units under units, tens under tens, and so on.**

✔ **NOTE:** Top number in the problem (original number is almost always larger than the bottom number [subtracted number]).

Example: Subtract 91 from 123.

$$\begin{array}{rl} 123 & \text{Original number} \\ \underline{-\,91} & \text{Subtracted number} \end{array}$$

2. **Subtract each column separately, beginning at bottom of units column.**

Example:

$$\begin{array}{rl} 123 & \\ \underline{-\,91} & \uparrow \\ 2 & \end{array}$$

3. **If a digit in the subtracted number is larger than the digit above it, "borrow" 1 from the top digit in the next column to the left, decreasing that digit by one and increasing the digit being subtracted by ten.**

Example:

$$\begin{array}{r} 123 \\ \underline{-91} \\ 32 \end{array}$$

4. **If there is nothing to borrow in the next column (column contains a zero), first borrow for that column from its next left column.**

Example:

$$\begin{array}{rrrr} 906 & 906 & 906 & 906 \\ \underline{-318} & \underline{-318} & \underline{-318} & \underline{-318} \\ & 8 & 88 & 588 \end{array}$$

5. **Check your subtraction by adding your answer to the subtracted number.**

Example:

| | Problem | | Check |
|---|---|---|---|
| 271 ↑ | Original number | 271 | Original number |
| − 164 | Subtracted number | −164 | |
| 107 | Answer | + 107 | |
| | | 271 | Check answer |

✔ **NOTE:** If you have solved the problem correctly, your check answer should be the same as the original number.

OBJECTIVE 6 **Multiply whole numbers to solve problems.**

1. **Set up problem by writing larger number (original number) above the smaller number (multiplier), writing units under units, tens under tens, and so on.**

✔ **NOTE:** You will get the correct answer (product) no matter which number is placed above the other, but the faster method places the larger above the smaller.

Example: Multiply the numbers 53 and 4.

| | |
|---|---|
| 53 | Original number |
| x 4 | Multiplier |

2. **If the multiplier contains only one digit, multiply each digit in the original number by it, working from right to left.**

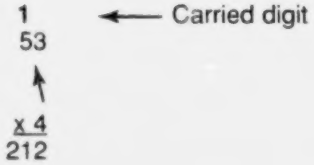
- Multiply units digit in original number by multiplier.
- Write answer units digit and insert necessary carry digit above next left column in original number as required.

Example:

$$\begin{array}{rl} 1 & \longleftarrow \text{Carried digit} \\ 53 & \\ \uparrow & \\ \underline{\times 4} & \\ 2 & \end{array}$$

- Multiply tens digit by multiplier and add carried digit as required.

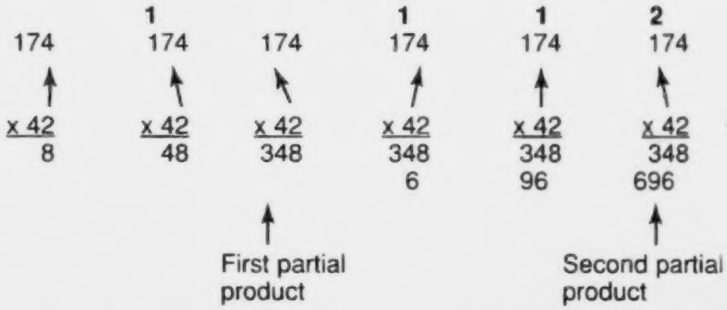
Example:


1
53
x 4
212
Carried digit

3. **If the multiplier contains more than one digit, find partial products.**

- Multiply each digit in original number by each digit in multiplier, moving from right to left.
- Align partial products so that right-hand digit of each is directly under its corresponding digit in the multiplier.

Example: Multiply the numbers 174 x 42.


174
x 42
8
1
174
x 42
48
174
x 42
348
1
174
x 42
348
6
1
174
x 42
348
96
2
174
x 42
348
696
First partial product
Second partial product

4. **Add the partial products.**

Example:

$$\begin{array}{r} 174 \\ \underline{\times 42} \\ 348 \\ \underline{+696} \\ 7308 \end{array}$$

Answer (product)

**OBJECTIVE 7** **Divide whole numbers to solve problems.**

1. **Set up problem by writing original number (number to be divided) inside a division frame, and by writing divisor (number you are dividing by) outside frame.**

Example: How many times will 34 go into 3347?

Divisor $34\overline{)3347}$ Original Number

2. **Determine how many times the divisor will go into the first digit of the original number. If it will not, write a zero in the answer space directly above the first digit. Then determine how many times the divisor will go into the first two numbers of the original number.**

✔ **NOTE:** Continue trying to divide the original number by the divisor until a set of digits can be divided. Remember to write a zero each time the set of digits cannot be divided.

Example:

$$\begin{array}{r} 0\phantom{000} \\ 34\overline{)3347} \end{array}$$

34 goes into 3 zero times.

$$\begin{array}{r} 00\phantom{00} \\ 34\overline{)3347} \end{array}$$

34 goes into 33 zero times.

$$\begin{array}{r} 009\phantom{0} \\ 34\overline{)3347} \end{array}$$

34 goes into 334 nine times.

3. **Multiply the divisor by the answer (digit above frame); write this answer under the digit(s) that divisor went into, and subtract.**

Example:

$$\begin{array}{r} 34 \\ \underline{\times 9} \\ 306 \end{array}$$

Multiply divisor (34) by answer (9).

$$\begin{array}{r} 009\phantom{0} \\ 34\overline{)3347} \\ \underline{-306\phantom{0}} \\ 28\phantom{0} \end{array}$$

4. **Bring down next unused digit from original number, and place it to the right of the subtracted difference (remainder)—even if the remainder is zero.**

Example:

$$\begin{array}{r} 009\phantom{0} \\ 34\overline{)3347} \\ \underline{306\phantom{0}} \\ 287 \end{array}$$

5. **Determine how many times the divisor will go into this new number; write your answer in the answer space above the digit that was brought down.**

Example

$$\begin{array}{r} 0098 \\ 34\overline{)3347} \\ \underline{306}\downarrow \\ 287 \end{array}$$

6. **Multiply the divisor by the last digit you wrote in the answer; write this product under the digits that divisor went into, and subtract.**

Example:

$$\begin{array}{r} 34 \\ \underline{\times 8} \\ 272 \end{array}$$

Multiply divisor (34) by answer (8).

$$\begin{array}{r} 0098 \\ 34\overline{)3347} \\ \underline{306\phantom{0}} \\ 287 \\ \underline{-272} \\ 15 \end{array}$$

Write product under 287, the digits that divisor went into, and subtract.

7. **Continue this process until all numbers in original number are used.**

8. **Write any remaining subtracted difference as a remainder.**

Example:

```
      0098
   34)3347
      306
       287
     - 272
        15     Remainder
```

9. **Check your answer by multiplying your answer times the divisor and adding the remainder to this number.**

✔ **NOTE:** If you have solved the problem correctly, your check answer should be the same as your original number.

Example:

```
       98    Answer
     x 34    Divisor
      392
     294
     3332
   +   15    Remainder
     3347    Check answer (Same as original number)
```

**OBJECTIVE 8** **Distinguish among types of fractions.**

1. **Proper**—Top number of fraction (numerator) is smaller than bottom number of fraction (denominator).

Example: $\frac{7}{8}$ Numerator / Denominator

2. **Improper**—Top number of fraction (numerator) is larger than bottom number of fraction (denominator) or the same as the bottom number.

Examples: $\frac{9}{8}$ $\frac{16}{16}$

3. **Mixed numbers**—Contain a whole number and a proper fraction.

Examples: 9 $^1/_2$, 1 $^7/_8$, 4 $^3/_4$

**OBJECTIVE 9** **Reduce fractions to lowest terms.**—Divide the numerator and denominator by the largest whole number that will go into each evenly.

Example: Reduce $^4/_{16}$ to its lowest terms.

$$\frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4}$$

✔ **NOTE:** The fraction $^1/_4$ is reduced to its lowest term because the numerator (1) and the denominator (4) cannot be divided by the same number.

**OBJECTIVE 10**

## Convert mixed numbers and improper fractions.

### 1. Converting mixed numbers to improper fractions

- Multiply the whole number by the denominator of the fraction.

Example: Convert 4 3/8 to an improper fraction.

$8 \times 4 = 32$

- Add your answer to the numerator.

Example: $32 + 3 = 35$

- Place this sum over the original denominator.

Example: $\frac{35}{8}$ Improper fraction

### 2. Converting improper fractions to mixed numbers

- Divide the numerator by the denominator.

Example: Convert 18/15 to a mixed number.

$$\begin{array}{r} 01 \\ 15\overline{)18} \\ \underline{15} \\ 3 \end{array} \text{ Remainder}$$

- Place the remainder over the denominator.

Example: $\frac{3}{15}$ $\frac{\text{Remainder}}{\text{Denominator}}$

- Reduce this fraction if necessary.

Example: $\frac{3}{15} = \frac{3 \div 3}{15 \div 3} = \frac{1}{5}$

- Add the reduced fraction to the whole number obtained by dividing the numerator by the denominator.

Example: $1 + \frac{1}{5} = 1\frac{1}{5}$ Mixed number

**OBJECTIVE 11**

## Add fractions to solve problems.

### 1. Like fractions

✔ **NOTE:** Like fractions are those having the same, or common, denominators.

Example: 1/4 and 2/4, 5/8 and 5/8, and 1/16 and 3/16

- Add the numerators.
- Place sum of numerators over common denominator.
- Convert to mixed numbers and reduce as required.

Example: Add 1/4 and 2/4.

$$\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}$$

Example: Add 5/8 and 5/8.

$$\frac{5}{8} + \frac{5}{8} = \frac{5+5}{8} = \frac{10}{8} = 10 \div 8 = 1\frac{2}{8} = 1\frac{1}{4}$$

Example: Add 1/16 and 3/16.

$$\frac{1}{16} + \frac{3}{16} = \frac{1+3}{16} = \frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4}$$

### 2. Unlike fractions

Examples: 11/12 and 3/9, 1/8 and 3/4

- Change to like fractions.
  - Find the lowest number into which each denominator can be divided evenly (lowest common denominator).
  - Multiply the numerators and denominators of each fraction by the number of times its denominator can be divided into the lowest common denominator.

Example: Add 11/12 and 3/9.

36 is lowest number into which both 12 and 9 can be divided evenly.

$36 \div 12 = 3$

$36 \div 9 = 4$

$$\frac{11}{12} = \frac{11 \times 3}{12 \times 3} = \frac{33}{36}$$

$$\frac{3}{9} = \frac{3 \times 4}{9 \times 4} = \frac{12}{36}$$

**Example:** Add $1/8$ and $3/4$.

8 is lowest number into which both 8 and 4 can be divided evenly.

$8 \div 8 = 1$

$8 \div 4 = 2$

$1/8$ remains as $1/8$ because 8 is the common denominator.

$$\frac{3}{4} = \frac{3 \times 2}{4 \times 2} = \frac{6}{8}$$

- Add like fractions and reduce or convert to mixed numbers as required.

**Example:** Add $11/12$ and $3/9$

$$\frac{11}{12} = \frac{33}{36} \text{ and } \frac{3}{9} = \frac{12}{36}$$

$$\frac{33}{36} + \frac{12}{36} = \frac{33 + 12}{36} = \frac{45}{36} = \frac{5}{4} = 1\frac{1}{4}$$

**Example:** Add $1/8$ and $3/4$

$$\frac{1}{8} \text{ remains } \frac{1}{8} \text{ and } \frac{3}{4} = \frac{6}{8}$$

$$\frac{1}{8} + \frac{6}{8} = \frac{1 + 6}{8} = \frac{7}{8}$$

3. **Mixed numbers**

- Add whole numbers.
- Add fractions, first finding common denominators if necessary, and reduce or convert to mixed numbers as necessary.
- Add the sums of steps 1 and 2.

**Example:** Add $3\ 1/8$ and $7\ 3/8$

Add whole numbers:

$3 + 7 = 10$

Add fractions and reduce:

$$\frac{1}{8} + \frac{3}{8} = \frac{1 + 3}{8} = \frac{4}{8} = \frac{1}{2}$$

Add the sums of steps 1 and 2:

$$10 + \frac{1}{2} = 10\frac{1}{2}$$

Example: Add 4 2/3 and 1 5/6

Add whole numbers:

$4 + 1 = 5$

Find common denominator:

$$\frac{2}{3} + \frac{5}{6} = \frac{4}{6} + \frac{5}{6}$$

Add fractions, convert to mixed number, and reduce:

$$\frac{4}{6} + \frac{5}{6} = \frac{9}{6} = 1\frac{3}{6} = 1\frac{1}{2}$$

Add the sums of steps 1 and 2:

$$5 + 1\frac{1}{2} = 6\frac{1}{2}$$

OBJECTIVE 12 **Subtract fractions to solve problems.**

1. **Like fractions**

   - Subtract smaller numerator from larger numerator.

     Example: Subtract 1/16 from 7/16.

     $7 - 1 = 6$

   - Place subtraction answer over common denominator.

     Example: $\frac{6}{16}$

   - Reduce to lowest terms as required.

     Example: $\frac{6}{16} = \frac{3}{8}$

2. **Unlike fractions**

   - Change to like fractions.

     Example: Subtract 1/2 from 3/4.

     3/4 remains the same because 4 is the common denominator.

     $$\frac{1}{2} = \frac{1 \times 2}{2 \times 2} = \frac{2}{4}$$

- Subtract as for like fractions.

$\frac{3}{4} - \frac{2}{4} = \frac{3-2}{4} = \frac{1}{4}$

- Reduce to lowest terms as required.

3. **Mixed numbers**

- Convert mixed numbers to like fractions.

Example: Subtract $3^1/_2$ from $5^1/_8$.

$5\frac{1}{8} - 3\frac{1}{2} =$

$5\frac{1}{8} - 3\frac{4}{8} =$

- Borrow a one from the original whole number if needed, convert the one to a like fraction, and add it to the smaller fraction.

✔ **NOTE:** This step is needed only if the like fraction in the original number is smaller than the like fraction in the subtracted number.

Example:

$5\frac{1}{8} - 3\frac{4}{8} = (4\frac{8}{8} + \frac{1}{8}) - 3\frac{4}{8}$

$= 4\frac{9}{8} - 3\frac{4}{8}$

- Subtract whole number from whole number and like fraction from like fraction.

Example: $4\frac{9}{8} - 3\frac{4}{8} = 1\frac{5}{8}$

**OBJECTIVE 13** **Multiply fractions to solve problems.**

1. **Convert mixed numbers to improper fractions if necessary.**
2. **Multiply numerators by numerators and denominators by denominators.**
3. **Write the product of the numerators over the product of the denominators.**
4. **Convert improper fractions to mixed numbers and reduce as required.**

Example: Multiply $^1/_2$ by $^3/_4$.

$\frac{1}{2} \times \frac{3}{4} = \frac{1 \times 3}{2 \times 4} = \frac{3}{8}$

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Example: Multiply $1\frac{1}{4}$ by $\frac{1}{2}$.

$1\frac{1}{4} \times \frac{5}{4}$ Convert to improper fraction.

$$\frac{5}{4} \times \frac{1}{2} = \frac{5 \times 1}{4 \times 2} = \frac{5}{8}$$

**Objective 14** **Label place values in a decimal number.**

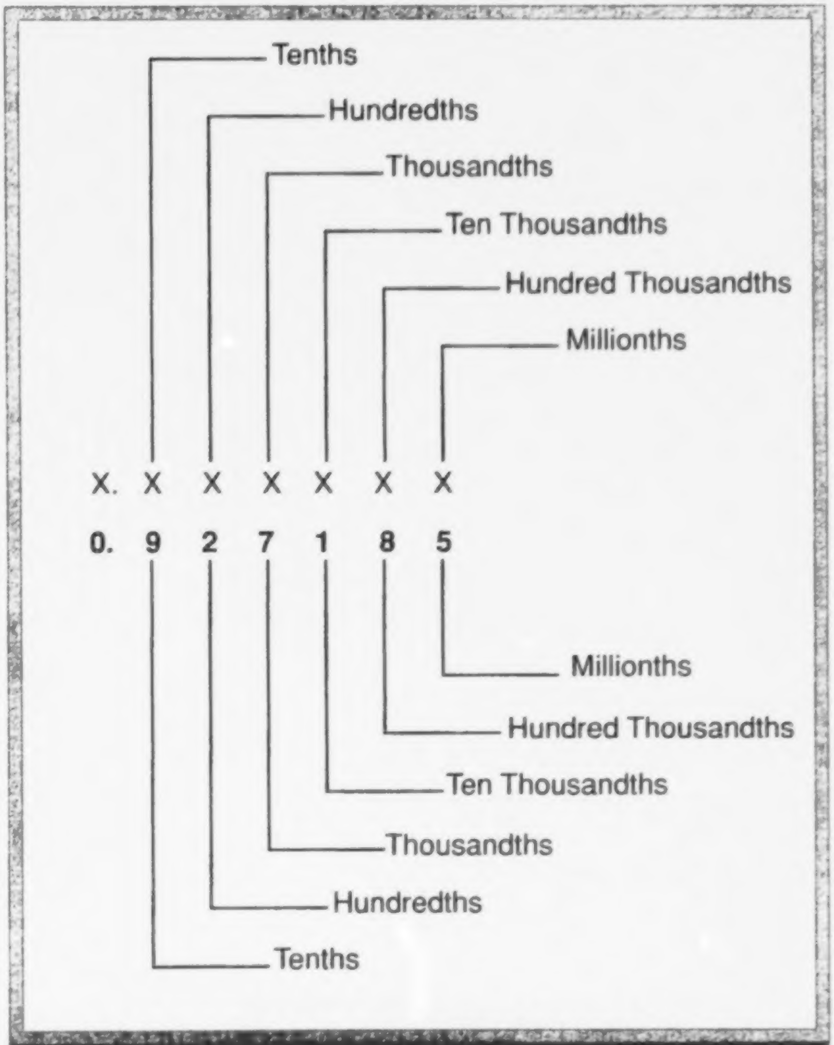
Tenths
Hundredths
Thousandths
Ten Thousandths
Hundred Thousandths
Millionths
X. X X X X X X
0. 9 2 7 1 8 5
Millionths
Hundred Thousandths
Ten Thousandths
Thousandths
Hundredths
Tenths

Figure 3—Decimal number

✓ **NOTE:** The number in the example is read as nine hundred twenty-seven thousandths, one hundred eighty-five millionths.

**OBJECTIVE 15** **Add decimal numbers to solve problems.**

1. **Set up problem as for addition of whole numbers, aligning decimal points directly under each other.**

   ✔ **NOTE:** Zeros may be added to ensure that units line up under units, tens under tens, and so on. Whole numbers have an understood decimal point to the right of the units digit: 7 is 7., 75 is 75., and 754 is 754.

   Example: Add 0.857, 2.1, 753, and 370.057.

   | | |
   |---|---|
   | 0.857 | 000.857 |
   | 2.1 | 002.100 |
   | 753 | 753.000 |
   | + 370.057 | + 370.057 |

2. **Add each column of numbers as for whole numbers.**

3. **Locate the decimal point in the answer by placing it directly under the decimal points above.**

   Example:

   000.857
   002.100
   753.000
   + 370.057
   1126.014 Answer

**OBJECTIVE 16** **Subtract decimal numbers to solve problems.**

1. **Set up problem as for subtraction of whole numbers, aligning decimal points directly under each other.**

   Example: Subtract 1.397 from 8.120.

   | | |
   |---|---|
   | 8.120 | Original number |
   | − 1.397 | Subtracted number |

2. **Subtract each column of numbers as for whole numbers.**

3. **Locate the decimal point in the answer by placing it directly under the decimal points above.**

4. **Check your subtraction by adding your answer to the subtracted number.**

✔ **NOTE:** If you have solved the problem correctly, your check answer should be the same as the original number.

Example:

| | |
|---|---|
| 8.120 | Original number |
| − 1.397 | Subtracted number |
| + 6.723 | Answer (difference) |
| 8.120 | Check answer |

### OBJECTIVE 17

**Multiply decimal numbers to solve problems.**

1. **Set up problem and multiply as for multiplication of whole numbers.**

✔ **NOTE:** Do **not** align the decimal points in columns when setting up multiplication problems for decimal numbers.

Example: Multiply 27.935 by 7.07.

$$\begin{array}{r l} 27.935 & \text{Original number} \\ \underline{\times\ \ 7.07} & \text{Multiplier} \\ 195545 & \\ \underline{955450\phantom{0}} & \\ 19750045 & \end{array}$$

2. **Add the number of decimal places to the right of the decimal points in the multiplier and original number.**

Example:

$$\begin{array}{r r l} 27.935 & 3 & \text{Decimal places} \\ \underline{\times\ 7.07} & \underline{+\ 2} & \text{Decimal places} \\ & 5 & \text{Total decimal places} \end{array}$$

3. **Locate the decimal point in answer by beginning at far right digit and counting off as many places to the left as the total decimal places found in step b.**

Example:

$$\begin{array}{r l} 27.935 & \\ \underline{\times\ \ \ \ 7.07} & \\ 195545 & \\ \underline{1955450\phantom{0}} & \\ 197.50045 & \text{5 decimal places} \end{array}$$

### OBJECTIVE 18

**Divide decimal numbers to solve problems.**

1. **Set up problem as for division of whole numbers.**

Example: Divide 0.25 by 0.005.

Divisor $0.005.\overline{)0.25}$ Original number

2. **Move the decimal point in the divisor to the right of the far right digit in the divisor.**

Example: $0.005.\overline{)0.25.}$

3. **Move the decimal point in the original number to the right by the same number of decimal places that you moved the decimal point in the divisor, adding zeros to the original number if necessary.**

Example: $0.005.\overline{)0.250.}$

✔ **NOTE:** If you are dividing a decimal number into a whole number, remember that whole numbers have an understood decimal point to the right of the units digit.

Example: $0.03\overline{)9\quad}$ becomes $0.03.\overline{)9.00.}$

4. **Place a decimal point in the answer space directly above the repositioned decimal point in the original number.**

   Example: $0.005.\overline{)0.250.}$ (with a decimal point placed in the answer space)

5. **Divide as for whole numbers.**

   Example:
   $$\begin{array}{r} 50. \\ 0005.\overline{)0250.} \\ \underline{025} \\ 00 \end{array}$$

6. **Check your division by multiplying the original divisor (before decimal point was moved) by your answer and adding any remainder to this number.**

   ✔ **NOTE:** If you have solved the problem correctly, your check answer should be the same as the original number.

   Example: 0.005 Divisor
   x 50 Answer
   0.250 Check answer (Same as original number)

**OBJECTIVE 19** **Convert fractions and percentages.**

1. **Converting decimal fractions to common fractions**

   - Remove the decimal point.
   - Place number over its respective denominator (10's, 100's, 1000's).
   - Cancel zeros when possible.
   - Reduce to lowest terms.

   Example: Convert .25 to a common fraction.

   $$.25 = 25 = \frac{25}{100} = \frac{1}{4}$$

   Example: Convert .520 to a common fraction.

   $$.520 = 520 = \frac{52\cancel{0}}{100\cancel{0}} = \frac{52}{100} = \frac{13}{25}$$

## 2. Converting common fractions to decimals and percentages

- Fractions to decimals—Divide the numerator by the denominator.

  Example: Convert $^5/_8$ to a decimal.

$$\frac{5}{8}\quad \begin{array}{l}\text{Numerator}\\ \text{Denominator}\end{array}\qquad \begin{array}{r} 0.625 \\ 8\overline{)5.000} \\ \underline{4\,8}\phantom{00} \\ 20\phantom{0} \\ \underline{16}\phantom{0} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

- Fractions to percentages—Divide the numerator by the denominator.

  ✔ **NOTE:** Percent means that a number is a fraction of 100.

  — Convert the fractions to decimals by dividing numerator by denominator.

  — Move the decimal point in the answer two places to the right.

  — Place the percent symbol after the number.

  Example: Convert $^7/_{33}$ to a percentage.

$$\frac{7}{33}\quad \begin{array}{l}\text{Numerator}\\ \text{Denominator}\end{array}\qquad \begin{array}{r} 0.2121 \\ 33\overline{)7.0000} \\ \underline{6\,6}\phantom{000} \\ 40\phantom{00} \\ \underline{33}\phantom{00} \\ 70\phantom{0} \\ \underline{66}\phantom{0} \\ 40 \\ \underline{33} \\ 7 \end{array} = 21.21\%$$

## 3. Converting percentages to fractions and decimal numbers

- Percentages to fractions

  — Drop the percent symbol.

  — Place the number over 100.

  — Reduce to lowest terms if necessary.

  Example: Convert 38% to a fraction.

$$38\% = 38$$

$$= \frac{38}{100}$$

$$= \frac{19}{50}$$

- Percentages to decimals
  - — Drop the percent symbol.
  - — Move the decimal point two places to left.

  Example: Convert 74% to a decimal.

  74% = 74

  = 0.74

**OBJECTIVE 20** **Solve percentage problems.**

✔ **NOTE:** Percentage problems may involve solving for the percent ("16 is what percent of 80?"), the part ("What number is 20% of 80?"), or the whole ("16 is 20% of what number?").

1. **Write the unknown as "X."**

   ✔ **NOTE:** The unknown may be the percent, the part, or the whole.

   Example: 16 is what percent of 80?

   16 is X percent of 80.

2. **Write the percent (known or unknown) as a fraction with a denominator of 100.**

   Example: 16 is $\frac{X}{100}$ percent of 80.

3. **Write the part and the whole as a fraction, writing the part as the numerator and the whole as the denominator.**

   Example: $\frac{16}{80}$ $\frac{\text{Part}}{\text{Whole}}$

4. **Set up the equation by writing the two fractions with an equal sign between them.**

   Example: $\frac{X}{100} = \frac{16}{80}$

5. **Solve the equation by multiplying the numerator of each fraction by the denominator of the other.**

   ✔ **NOTE:** This process is known as *cross multiplying.*

   Example: $\frac{X}{100} = \frac{16}{80}$

   $80X = 1600$

6. **Divide each side of the equation by the multiplier of X.**

   Example: $80X = 1600$

   $X = 20\%$

   16 is 20% of 80.

Objective 21 **Convert Roman numerals to Arabic numerals.**

| Roman numerals | Arabic numerals | Roman numerals | Arabic numerals | Roman numerals | Arabic numerals |
|---|---|---|---|---|---|
| ss,$\overline{\text{ss}}$ | 1/2 | X | 10 | C | 100 |
| I | 1 | XV | 15 | D | 500 |
| II | 2 | XX | 20 | M | 1000 |
| III | 3 | XXX | 30 | | |
| IV | 4 | XL | 40 | | |
| V | 5 | L | 50 | | |
| VI | 6 | LX | 60 | | |
| VII | 7 | LXX | 70 | | |
| VIII | 8 | LXXX | 80 | | |
| IX | 9 | XC | 90 | | |

Figure 4—Roman numerals to Arabic numerals

1. **If a Roman numeral precedes a Roman numeral of greater value, then *subtract* the lesser numeral from the greater one.**

   Example: IV = 5 - 1 = 4

2. **If a Roman numeral follows a Roman numeral of greater value, then *add* the lesser numeral to the greater one.**

   Example: VI = 5 + 1 = 6

3. **If Roman numerals of equal value follow one another, then add their values.**

   Examples: II = 1 + 1 = 2; XXX = 10 + 10 + 10 = 30

✔ **NOTE:** Roman numerals are never repeated in sequence more than three times.

4. **If a Roman numeral is placed between two others of greater value, then subtract the middle numeral from the numeral following it.**

   Example: CXC = [100 + (100-10)] = 190

**OBJECTIVE 22**

## Assignment Sheet 1—Add Whole Numbers

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Completed all problems and showed work | ______ |
| • Computed a minimum of 18 of the 20 answers correctly per Assignment Sheet 1 answers | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

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**EXERCISE**

**DIRECTIONS** Solve the following addition problems.

Examples:

$$\begin{array}{r} 5 \\ \underline{+\ 10} \\ 15 \end{array} \qquad \begin{array}{r} 1 \\ 67 \\ \underline{+\ 25} \\ 92 \end{array} \leftarrow \text{Carried digit} \qquad \begin{array}{r} 11 \\ 539 \\ 333 \\ \underline{+\ 432} \\ 1304 \end{array} \leftarrow \text{Carried digits}$$

a. Solve each of the following addition problems. Show your work.

$$1.\ \begin{array}{r} 2 \\ \underline{+\ 9} \end{array} \qquad 2.\ \begin{array}{r} 8 \\ \underline{+\ 8} \end{array} \qquad 3.\ \begin{array}{r} 7 \\ \underline{+\ 6} \end{array} \qquad 4.\ \begin{array}{r} 15 \\ \underline{+\ 8} \end{array} \qquad 5.\ \begin{array}{r} 81 \\ \underline{+\ 27} \end{array}$$

$$6.\ \begin{array}{r} 7 \\ 38 \\ \underline{+\ 43} \end{array} \qquad 7.\ \begin{array}{r} 55 \\ 88 \\ \underline{+\ 99} \end{array} \qquad 8.\ \begin{array}{r} 341 \\ 428 \\ \underline{+\ 769} \end{array} \qquad 9.\ \begin{array}{r} 472 \\ 564 \\ \underline{+\ 881} \end{array} \qquad 10.\ \begin{array}{r} 9876 \\ 5432 \\ \underline{+\ 1122} \end{array}$$

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. The scrub has 12 pairs of sterile gloves. She has asked for and received from the circulator an additional 8 pairs. How many total pairs of gloves does she have?

   Total pairs of gloves = ________________

2. On the back table there are 4 packs of 3-0 silk, 6 packs of 2-0 chromic and 1 pack of 4-0 plain. How many total packs of sutures are on the back table?

   Total packs = ________________

3. The operating room completed 112 cases on Monday, 62 cases on Tuesday, 75 cases on Wednesday, and 82 cases on Thursday. How many total cases were completed during those four days?

   Total cases = ________________

4. The patient will be billed $530 for the use of the operating room, $82 for suture, $127 for local anesthetic medications, and $12 for oxygen. What is the total cost?

   Total cost = ________________

5. You worked 7 hours on Monday, 11 hours on Tuesday, 4 hours on Wednesday, 10 hours on Thursday, and 8 hours on Friday. What was your total time for the week?

   Total time = ________________

6. An instrument set has 22 kelly clamps, 5 scissors, 8 mosquitoes, and 6 retractors. What is the total instrument count?

   Total instrument count = ______________

7. There are 3 instrument sets for the first case, 7 instruments sets for the second case, and 65 instrument sets for the third case. How many total instrument sets have been pulled for the three cases?

   Total instrument count = ______________

8. The scrub person did 6 cases during one day. On each case he used several packs of sutures. The number of packs of suture that he used was 65, 75, 69, 81, 57, and 76. What was the total number of packs of suture?

   Total packs of suture = ______________

9. The circulator was weighing the blood-soaked sponges being thrown off the field. The first sponge weighed 40 gm more than dry a sponge, the second sponge weighed 60 gm more than a dry sponge, and the third sponge weighed 35 gm more than a dry sponge. What was the total blood loss in these three sponges?

   Total blood loss = ______________

10. The plastic surgeon was suturing several lacerations on a little girl's face. He was measuring each laceration and announcing the length of each. The first length was 12 cm, the second length was 18 cm, and the third length was 8 cm. What wa the total length of the lacerations?

    Total length of lacerations = ______________

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**OBJECTIVE 23**

## Assignment Sheet 2—Subtract Whole Numbers

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Completed all problems and showed work | ______ |
| • Computed a minimum of 20 of the 24 answers correctly per Assignment Sheet 2 answers | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________________

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**EXERCISE**

**DIRECTIONS** Solve the following subtraction problems.

| | | | | |
|---|---|---|---|---|
| Examples: | 12 | Original number | 57 | Original number |
| | − 7 | Subtracted number | − 35 | Subtracted number |
| | + 5 | Answer (difference) | + 22 | Answer (difference) |
| | 12 | Check answer<br>(Same as original number) | 57 | Check answer |

a. Solve each of the following subtraction problems. Check your answer by adding the difference to the subtracted number. Show your work.

| | | | | |
|---|---|---|---|---|
| 1. 9<br>− 5 | 2. 15<br>− 8 | 3. 75<br>− 22 | 4. 453<br>− 47 | 5. 742<br>− 318 |
| 6. 981<br>− 698 | 7. 1420<br>− 245 | 8. 3459<br>− 1649 | 9. 55722<br>− 4272 | 10. 98679<br>− 8957 |

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. The surgeon has asked for 18 packs of suture, you have 7, how many additional packs of suture do you need?

   Additional packs of suture needed= ______________

2. You opened 18 packs of suture for a case and the surgeon used 6 of them, how many extra many packs of suture did you open?

   Extra packs of suture = ______________

3. You worked 36 hours last week and a co-worker worked 58 hours. How many more hours did your co-worker work than you did?

   More hours worked= ______________

4. Last year surgery did 1219 cases. This year they did 2167 cases. How many additional cases did surgery do this year than last?

   Additional cases = ______________

5. The surgeon has to put in 20 screws, which should take 40 minutes. If the surgeon has been putting in screws for 12 minutes, how much longer will it take to put in all of the screws?

   Minutes left = ______________

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6. The suture supply cabinet has 240 packs of one type of suture. If 98 are used today, how many will remain in the supply cabinet?

   Packs remaining in supply cabinet = _______________

7. The surgeon usually makes an incision 120 mm long for a particular operation. Today he made the incision 164 mm long. How much longer than his usual length was today's incision?

   Length incision was longer today = _______________

8. You can work only 13 hours this week. The following week you can work 6 hours. How much additional time will it take the third week if the job will take 27 total hours?

   Additional hours = _______________

9. Surgery uses 550 sterile gowns each week. There are 200 on the shelf in supply. How many additional sterile gowns will be needed for this week?

   Additional sterile gowns needed = _______________

10. The counter on the lithotripsy machine reads 1250, and at the end of the procedure it reads 6000. How many additional shocks were administered to the patient?

    Additional shocks administered = _______________

**OBJECTIVE 24**

## Assignment Sheet 3—Multiply Whole Numbers

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Completed all problems and showed work ________
- Computed a minimum of 18 of the 20 answers correctly per Assignment Sheet 3 answers ________

**Overall rating** ________

Evaluator's comments ________________________________________

**EXERCISE**

**DIRECTIONS** Solve the following multiplication problems.

```
Examples:        1 ← Carried digit     11  ← Carried digits
           8    53                    756
          x 7   x 4                  x 312
          56   212                   1512  ← First partial product
                                      756  ← Second partial product
                                   2268    ← Third partial product
                                   235872 ← Product
```

a. Solve each of the following multiplication problems. Show your work.

```
 1.    6     2.    9     3.   54     4.   721     5.   1682
      x 7         x 8        x 6         x 4            x 5

 6.   78     7.  453     8.  314     9.  2143    10.   4123
    x 26        x 47       x 527       x 235         x 1324
```

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. There are 2 people working in each operating room, and there are 8 operating rooms. What is the total number of people working?

   Total people working = _______________

2. There are 32 packs of suture in a box, you have 8 boxes, how many packs of suture do you have?

   Total packs of suture = _______________

3. There are 8 needles in each multipack of suture. You have 3 multipacks. How many needles do you have?

   Total needles = _______________

4. It takes 23 sutures for each heart valve and you are putting in 3 valves. How many sutures will you need?

   Total sutures = _______________

5. There are 8 operating rooms and each has 1 scrub tech. Each scrub tech works 40 hours per week. How many total hours are worked each week by these 8 scrub techs?

   Total hours = _______________

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6. If a pack of suture costs $6.00, how much will 45 packs of suture cost?

Total cost = ______________

7. If it takes 45 minutes to turn over a room, how much time will be spent turning over a room with 5 cases?

Total time spent = ______________

8. Central supply can sterilize 50 instrument sets in an hour. How many instrument sets can be sterilized in 8 hours?

Total instrument sets = ______________

9. Figure the amount of time worked in 4 weeks by 12 scrub techs who work 32 hours per week.

Total hours = ______________

10. One scrub does 6 cases per day for 5 days, another scrub does 4 cases per day for 8 days, a third scrub does 9 cases per day for 4 days. What is the total number of cases done by three persons?

Total cases = ______________

**OBJECTIVE 25**

## Assignment Sheet 4—Divide Whole Numbers

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Completed all problems and showed work | _______ |
| • Computed a minimum of 14 of the 16 answers correctly per Assignment Sheet 4 answers | _______ |
| **Overall rating** | _______ |

Evaluator's comments ______________________________

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**EXERCISE**

**DIRECTIONS** Solve the following division problems.

```
Examples:            Answer              324
             Divisor )Original number   3)972
                                          9
                                          7
                                          6
                                          12
                                          12

        0111   Answer       Check:   111  Answer
     51)5678                       x  51  Divisor
        51                           111
         57                         555
         51                         5661
          68                       +  17  Remainder
          51                        5678  Original number
          17   Remainder
```

a. Solve each of the following division problems. Check your answers by multiplying the divisor by the answer. Show your work.

1. $2\overline{)8}$
2. $6\overline{)48}$
3. $9\overline{)819}$
4. $4\overline{)1248}$
5. $13\overline{)39}$
6. $66\overline{)198}$
7. $84\overline{)5212}$
8. $124\overline{)345}$
9. $464\overline{)829}$
10. $746\overline{)2872}$

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. A syringe holds 5 cc, how many times can it be filled from a 50 cc bottle of Xylocaine?

   Total refills = ______________

2. Jane received $440.00 for a week's work. She worked 40 hours. How much was she paid per hour?

   Total per hour = ______________

3. It takes 2 hemostats to clamp and cut a blood vessel during a colectomy. There are 22 hemostats in the instrument set. How many blood vessels can be cut and clamped before you run out of clamps?

   Total blood vessels = ______________

4. Joel wraps instruments during his lunch break. He has time after eating to wrap 4 sets. How many days will it take him to wrap 92 sets of instruments?

   Total days = ______________

5. A new operating microscope costs $120,000.00. How much will the hospital pay per month if it finances the microscope at 0% interest for 36 months?

   Total per month = ______________

6. A sales rep has 300 donuts. If she leaves 60 donuts at each operating room that she visits, how many operating rooms can she visit before she runs out of donuts?

   Total operating rooms = ______________

# Introduction to Surgical Technology
# Section D: Pharmacology
# Module 1-D: Basic Math

OBJECTIVE 26

## Assignment Sheet 5—Reduce Fractions to Lowest Terms

Name ______________________________ Date ______________

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**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 8 of the 10 answers correctly per Assignment Sheet 5 answers ______

**Overall rating** ______

Evaluator's comments ______________________________

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EXERCISE

DIRECTIONS

Reduce the following fractions to their lowest terms.

Example: $\frac{9}{12} = \frac{9 \div 3}{12 \div 3} = \frac{3}{4}$ $\frac{12}{32} = \frac{12 \div 4}{32 \div 4} = \frac{3}{8}$

A. $^{4}/8 =$ ____________

B. $^{8}/16 =$ ____________

C. $^{2}/2 =$ ____________

D. $^{4}/16 =$ ____________

E. $^{12}/48 =$ ____________

F. $^{9}/24 =$ ____________

G. $^{16}/32 =$ ____________

H. $^{2}/4 =$ ____________

I. $^{9}/12 =$ ____________

J. $^{50}/100 =$ ____________

Introduction to Surgical Technology
Section D: Pharmacology
Module 1-D: Basic Math

OBJECTIVE 27

## Assignment Sheet 6—Convert Fractions to Mixed Numbers

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 30 of the 35 answers correctly per Assignment Sheet 6 answers ______

**Overall rating** ______

Evaluator's comments ______________________________

EXERCISE

DIRECTIONS Convert the following fractions and mixed numbers. Reduce to lowest terms when possible.

a. Distinguish among the following fractions by writing a "P" in the blanks before a proper fraction, an "I" before an improper fraction, and an "M" in the blanks before a mixed number.

_____ 1. 1/2
_____ 2. 3 7/8
_____ 3. 16/2
_____ 4. 3 1/8
_____ 5. 1/4
_____ 6. 1/1
_____ 7. 7/2
_____ 8. 8 1/2
_____ 9. 4/4
_____ 10. 9 3/16
_____ 11. 5 1/2
_____ 12. 9/8
_____ 13. 9/4
_____ 14. 1/8
_____ 15. 16 3/4

b. Convert each of the following mixed numbers to improper fractions. Reduce to lowest terms when possible.

1. 3 1/4 = ____________
2. 4 1/2 = ____________
3. 7 3/4 = ____________
4. 8 1/2 = ____________
5. 6 1/8 = ____________
6. 5 2/4 = ____________
7. 4 1/4 = ____________
8. 8 1/2 = ____________
9. 9 1/4 = ____________
10. 16 1/2 = ____________

c. Convert each of the following improper fractions to mixed numbers. Reduce to lowest terms when possible.

1. 7/4 = ____________
2. 9/2 = ____________
3. 6/4 = ____________
4. 15/8 = ____________
5. 19/16 = ____________
6. 11/8 = ____________
7. 75/32 = ____________
8. 5/2 = ____________
9. 15/4 = ____________
10. 33/16 = ____________

Introduction to Surgical Technology
Section D: Pharmacology
Module 1-D: Basic Math

**OBJECTIVE 28**

## Assignment Sheet 7—Add Fractions

Name ______________________________ Date ________________

**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 17 of the 19 answers correctly per Assignment Sheet 7 answers ______

**Overall rating** ______

Evaluator's comments ______________________________

**EXERCISE**

**DIRECTIONS**

Adding like fractions:*

Examples: Add $^{3}/_{4}$ and $^{3}/_{4}$.

1. Add the numerators.

   Example: 3 + 3 = 6

2. Place answer over common denominator and reduce to lowest terms if necessary.

   Example: $^{6}/_{4} = 1\ ^{2}/_{4} = 1\ ^{1}/_{2}$ Answer

Adding unlike fractions:

Examples: Add $^{1}/_{4}$ and $^{7}/_{8}$.

1. Change to equivalent fractions with lowest common denominator.

   Example: $^{7}/_{8}$ remains the same, as 8 is lowest common denominator.

   $^{1}/_{4}$ is multiplied by $^{2}/_{2}$, or $^{1}/_{4} \times {}^{2}/_{2} = {}^{2}/_{8}$.

2. Add the numerators.

   Example: $\frac{7+2}{8} = 9/8$

3. Change improper fraction to mixed number and reduce to lowest terms if necessary.

   Example: $9/8 = 9 \div 8 = 1\ 1/8$ Answer

Adding mixed numbers:

Example: Add $3\ 5/8 + 7\ 5/8$.

1. Add numerators.

   Example: $\frac{5+5}{8} = 10/8$

2. Change improper fraction to mixed number and reduce to lowest terms if necessary.

   Example: $10/8 = 10 \div 8 = 1\ 2/8 = 1\,1/4$

3. Add whole numbers and fractions.

   Example: $3 + 7 + 1 + 1/4 = 11\ 1/4$ Answer

a. Add the following fractions. Show your work in the space provided below the problems. Reduce to lowest terms if necessary. Write your answers on the blanks beside the problems.

1. $7/16 + 5/16 =$ ______
2. $5/8 + 7/8 =$ ______
3. $1/4 + 2/8 =$ ______
4. $4/16 + 3/4 =$ ______
5. $9/16 + 5/8 =$ ______
6. $5/8 + 5/32 =$ ______
7. $3/4 + 5/32 =$ ______
8. $7/8 + 6/16 =$ ______
9. $9/16 + 3/4 =$ ______
10. $4/4 + 25/32 =$ ______

b. Solve the following problems. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. Add the lengths of two intermedulary rods that are 6 1/2 inches and 8 1/4 inches.

   Total length in inches = ____________________

2. Carlos worked 4 1/2 hours before lunch and 3 1/4 hours after lunch. How many hours did Carlos work?

   Total hours = ____________________

3. Add the lengths of three screws that are 2 1/8 inches, 3 1/4 inches, and 1 13/16 inches.

   Total length = ____________________

4. Three Kirshner wires have lengths of 6 5/8 inches, 6 1/4 inches, and 6 3/4 inches. What are their total lengths?

   Total length = ____________________

5. In learning to read an English rule, Rhonda located 4 7/8 inches, Roberta located 3 15/16 inches, and Ben located 4 1/4 inches. How many total inches were located?

   Total inches = ____________________

6. Add the lengths of three segments of V/P shunt tubing: 17 15/16 inches, 16 3/4 inches, and 25 3/8 inches.

   Total inches = ____________________

7. Three dimensions are 1 $^{11}/_{16}$ inches, 2 $^{3}/_{8}$ inches, and 2 $^{3}/_{4}$ inches. What is the combined dimension?

   Total dimension = ____________________

8. A graduate pitcher of irrigation has 1 $^{1}/_{2}$ liters in it. Jamie adds 1 $^{3}/_{4}$ liters. How many liters are in the container?

   Total liters = ____________________

9. A private scrub nurse works 5 $^{7}/_{8}$ hours, 3 $^{3}/_{4}$ hours, and 7 $^{7}/_{16}$ hours on three cases. How many total hours did the scrub work?

   Total hours = ____________________

**OBJECTIVE 29**

## Assignment Sheet 8—Subtract Fractions

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Completed all problems and showed work | _____ |
| • Computed a minimum of 38 of the 43 answers correctly per Assignment Sheet 8 answers | _____ |
| **Overall rating** | _____ |

Evaluator's comments ______________________________________________

___________________________________________________________________

___________________________________________________________________

**EXERCISE**

**DIRECTIONS**

Subtracting like fractions:

Examples: Subtract 1/16 from 7/16.

1. Subtract smaller numerator from larger numerator.

   Example: 7 – 1 = 6

2. Place answer over common denominator.

   Example: 6/16

3. Reduce to lowest terms if required.

   Example: 6/16 = 3/8 Answer

Subtracting unlike fractions:

Example: Subtract 1/2 from 3/4.

1. Change to like fractions.

   Example: 3/4 remains the same because 4 is the common denominator.

   1/2 is multiplied by 2/2, or 1/2 x 2/2 = 2/4.

2. Subtract as for like fractions and reduce to lowest terms if required.

   Example: $3/4 - 2/4 = 1/4$ = Answer

Subtracting mixed numbers:

Example: Subtract $3\ 1/2$ from $5\ 1/8$.

1. Change mixed numbers to like fractions.

   Example: $3\ 1/2 = 3\ 4/8$

2. Borrow a 1 from the original whole number if needed, and convert the 1 to a like fraction, and add it to the smaller fraction.

   Note: This step is needed only if the like fraction in the original number is smaller than the like fraction in the subtracted number.

   Example: $5\ 1/8 - 1\ 4/8 = (4\ 8/8 + 1/8) - 3\ 4/8 = 4\ 9/8 - 3\ 4/8$

3. Subtract whole number from whole number and like fraction from like fraction, and reduce answer to lowest terms if required.

   Example: $4\ 9/8 - 3\ 4/8 = 1\ 5/8$ Answer

Subtracting a fraction from a whole number:

Example: $4 - 3/16$

1. Borrow 1 from whole number.

   Example: $4 - 1 = 3$

2. Change borrowed 1 to like fraction.

   Example: $1 = 16/16$

3. Subtract as for like fractions and reduce answer to lowest terms if required.

   Example: $3\ 16/16 - 3/16 = 3\ 13/16$ Answer

a. Subtract the proper fractions given below. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $3/4 - 3/16 =$ ____________
2. $7/8 - 1/4 =$ ____________
3. $30/32 - 3/4 =$ ____________
4. $25/32 - 5/8 =$ ____________
5. $7/8 - 2/16 =$ ____________
6. $15/16 - 3/8 =$ ____________
7. $1/2 - 7/16 =$ ____________
8. $3/4 - 3/8 =$ ____________
9. $13/16 - 9/32 =$ ____________
10. $7/8 - 6/16 =$ ____________

b. Subtract the following fractions from whole numbers. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $4 - 3/4 =$ ____________
2. $7 - 15/16 =$ ____________
3. $32 - 13/32 =$ ____________
4. $175 - 4/5 =$ ____________
5. $12 - 61/64 =$ ____________

c. Subtract the following mixed numbers from whole numbers. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $2 - 1\frac{1}{3} =$ ________
2. $3 - 1\frac{3}{8} =$ ________
3. $18 - 9\frac{7}{8} =$ ________
4. $3 - 1\frac{21}{32} =$ ________
5. $27 - 1\frac{5}{16} =$ ________
6. $14 - 6\frac{3}{4} =$ ________
7. $5 - (3\frac{5}{32} + 1\frac{9}{32}) =$ ______
8. $8 - (1\frac{1}{4} + 5\frac{5}{8} + \frac{1}{16}) =$ ____
9. $4 - 3\frac{1}{3} =$ ________
10. $42 - 3\frac{7}{16} =$ ________

d. Subtract the following mixed numbers. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. $1\frac{3}{5} - 1\frac{1}{5} =$ ________
2. $72\frac{6}{16} - 22\frac{7}{16} =$ ____
3. $7\frac{5}{6} - 2\frac{1}{6} =$ ________
4. $18\frac{7}{8} - 9\frac{3}{8} =$ ______
5. $35\frac{5}{8} - 8\frac{1}{2}$ ________
6. $5\frac{1}{4} - (1\frac{1}{8} + 1\frac{7}{8}) =$ ____
7. $12\frac{1}{2} - (7\frac{1}{4} + 3\frac{1}{8}) =$ __
8. $4\frac{29}{32} - 1\frac{19}{32} =$ ________
9. $5\frac{15}{32} - 2\frac{31}{32} =$ ________
10. $8\frac{1}{16} - 4\frac{7}{8} =$ ________

e. Solve the following word problems. Show your work in the spaces provided. Reduce to lowest terms if necessary. Write your answers on the blanks.

1. The surgeon asked for a 7/8 inch screw. Jim gave him a 3/4 inch screw. How much difference is there in the length of the screws?

   Difference in inches = ____________________

2. Loraine wrapped 20 instrument sets in 5 1/4 hours. Tony wrapped the same sets the next day in 4 1/4 hours. How much faster did Tony work than Loraine?

   Difference in hours = ____________________

3. The operating room table is 4 1/2 feet from the wall. Two pieces of rubber will be placed between the table and the wall. If one piece of rubber is 1 5/8 feet wide, how wide must the second piece be to touch the table?

   Width of rubber in feet = ____________________

4. Three lengths of suture are cut from a 35 1/2 inch spool The lengths are 7 1/4 inches, 11 3/8 inches, 6 1/2 inches. If 3/8 inch of suture is wasted in cutting, how much suture is left?

   Length of suture left in inches= ____________________

5. A piece of felt is 32 1/2 inches long. Short pieces of the following lengths were cut from it: 6 1/2 inches, 5 1/4 inches, 8 13/16 inches, and 10 9/16 inches. How much felt is left?

   Length of felt left in inches = ____________________

6. A large stock container of Betadine contains 16 $^3/_{10}$ gallons of Betadine solution. After using 9 $^3/_4$ gallons, how many gallons will be left?

   Number of gallons = ____________________

7. A container of alcohol holds 4 $^1/_4$ liters. How much alcohol is left after using $^1/_2$ liter to fill the hypothermia machine?

   Amount of alcohol left in liters = ____________________

8. A length of VP shunt tubing is $^1/_8$ inch by 10 inches. If 1 $^3/_8$ inches are cut from its length, what will the final length of the VP shunt tubing be?

   Shunt tubing length in inches = ____________________

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 1-D: Basic Math

**OBJECTIVE 30**

## Assignment Sheet 9—Multiply Fractions

Name ______________________________ Date ______________

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**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 9 of the 11 answers correctly per Assignment Sheet 9 answers ______

**Overall rating** ______

Evaluator's comments ______________________________

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**EXERCISE**

**DIRECTIONS** Solve the following multiplication problems.

Example:

$\frac{2}{3} \times \frac{3}{4}$ becomes $\frac{2 \times 3}{3 \times 4} = \frac{6}{12} = \frac{1}{2}$

a. Multiply the following fractions. Convert mixed fractions where needed and reduce answers to lowest terms.

1. $\frac{1}{2} \times \frac{3}{4} =$ ________
2. $1\frac{1}{2} \times 2\frac{1}{4} =$ ________
3. $\frac{7}{8} \times \frac{2}{3} =$ ________
4. $\frac{1}{4} \times \frac{1}{3} \times \frac{1}{2} =$ ________
5. $\frac{3}{8} \times \frac{5}{16} =$ ________
6. $\frac{1}{2} \times 6\frac{1}{2} =$ ________
7. $1\frac{1}{3} \times 2\frac{1}{4} \times \frac{1}{2} =$ ________
8. $2\frac{3}{4} \times 6\frac{1}{8} =$ ________

b. Solve the following word problems. Show your work in the space provided. Write your answers on the blanks.

1. A certain mixture of chemicals requires $^3/_4$ gallon of concentrate and $^1/_4$ gallon of water to mix a gallon of mixture. How much concentrate should be used to mix only $^1/_3$ gallon of mixture?

   Amount of concentrate = ____________________

2. There are 296 packages of suture in a case. How many packages of suture are there in $^1/_4$ of a case?

   Number of packages of suture = ____________________

3. After wrapping instruments for the day, central supply has 8 $^2/_3$ pounds of wrap left in three different sizes. If one-half of the wrap is size 2, how many pounds of size 2 wrap are left?

   Pound of size wrap left = ____________________

## Introduction to Surgical Technology
## Section D: Pharmacology
## Module 1-D: Basic Math

**OBJECTIVE 31**

# Assignment Sheet 10—Add Decimal Numbers

Name ____________________ Date __________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Completed all problems and showed work | ______ |
| • Computed a minimum of 35 of the 40 answers correctly per Assignment Sheet 10 answers | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________

________________________________________________

________________________________________________

**EXERCISE**

**DIRECTIONS** Solve the following decimal addition problems.

a. Write the name of the place for each *underlined* digit.

__________ 1. $867.\underline{4}3$

__________ 2. $6.3\underline{7}892$

__________ 3. $1.000\underline{8}$

__________ 4. $6.239\underline{5}$

__________ 5. $0.47\underline{6}$

b. Write the name of the place for the last digit in each of the following numbers.

__________ 1. 0.38

__________ 2. 0.4678

__________ 3. 321.9

__________ 4. 427.389

__________ 5. 44.67

c. Underline the digit that is in the place named in italics.

1. 46.3826 *Hundredths*
2. 35.0038 *Ten thousandths*
3. 148.296 *Tenths*
4. 6758.23 *Hundredths*
5. 91.4082 *Thousandths*
6. 204.37 *Tens*
7. 14.0079 *Ones (units)*
8. 208.097 *Hundredths*
9. 5.23981 *Thousandths*
10. 502.967 *Tenths*
11. 5230.867 *Thousandths*
12. 587.029 *Ones (units)*
13. 0.298 *Hundredths*
14. 329.768 *Tens*
15. 52.694 *Thousandths*
16. 498.276 *Tenths*
17. 0.5296 *Ten thousandths*
18. 468.539 *Hundredths*
19. 324.06 *Tenths*
20. 567.8 *Ones (units)*

d. Set up the following groups of numbers in columns. Add each column, carrying when necessary and placing the decimal point correctly.

1. 0.024 + .165
2. 87.3 + 370
3. 15.127 + 3.4 + .0091 + 236.87
4. 195.7 + 83 + 9.006
5. .5280 + 435 + 179.50 + 1.9

e. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. Motoaki earned $22.50 in overtime and his friend Maria earned $16.50. How much did they earn together?

   Total amount earned = ________________

2. For one day's work, John earned $54.65 in regular time, $16.30 in overtime, and $3.38 in reimbursable expenses. What was John's total income for the day?

   Total income for the day = ________________

3. Gwen worked four days last week. She worked 6.8 hours on Monday, 7.4 hours on Tuesday, 5.3 hours on Wednesday, and 4.4 hours on Thursday. How many total hours did she work?

   Total hours worked = ________________

4. Daniel was sorting out the supply cabinet. He found three partially used bottles of Betadine, each containing the following amounts: 6.7 liters, 12.0 liters, and .5 liters. How many total liters of Betadine were in the cabinet?

   Total liters = ________________

5. In one month, surgery had the following expenses: equipment repair, $268.96; suture, $142.37; cleaning supplies, $160.16; copy machine rent, $116.27; and labor, $15,312.50. What was surgery's total monthly expense?

   Total monthly expense = ________________

**OBJECTIVE 32**

# Assignment Sheet 11—Subtract Decimal Numbers

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 12 of the 15 answers correctly per Assignment Sheet 11 answers ______

**Overall rating** ______

Evaluator's comments ______________________________

---

**EXERCISE**

**DIRECTIONS** Solve the following decimal subtraction problems.

a. Set up each of the following problems in column form. Subtract and check your work. Remember, when you subtract decimals, the decimal points must be aligned.

1. 868.87 – 516.89 = __________

2. 567 – 19.856 = __________

3. 198 – 56.987 = __________

4. 567.94 – 59.78 = __________

5. $815.23 – $65.98 = __________

6. $20.03 – $15.88 = __________

7. 694.7 – 24.3 = __________

8. 5,000 – 892.66 = __________

9. $15 – $12.53 = __________

10. $219.30 – $21.85 = __________

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. A surgeon received $8438.64 last week, and paid out $5121.32. How much profit did he make?

   Profit = ________________

2. It is estimated that the operation will take 20.5 hours to finish. The operation has been going for 6 hours. How much longer will it take to finish?

   Hours required to finish job = ________________

3. A length of suture 6.14 inches long was cut from a length 8.98 inches long. How much suture was left?

   Inches of suture left = ________________

4. The supply container holds 49.2 liters of cleaning solution. After one day, 8.7 liters have been used. How much cleaning solution was left in the container?

   Liters of cleaning solution left in the container = ________________

5. You have a length of VP shunt tubing 27.5 inches long. The amount that you need is 55 inches. How many more inches of VP shunt tubing do you need?

   Inches of tubing needed = ________________

**OBJECTIVE 33**

## Assignment Sheet 12—Multiply Decimal Numbers

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 14 of the 16 answers correctly per Assignment Sheet 12 answers ______

**Overall rating** ______

Evaluator's comments ____________________________________________

_________________________________________________________________

_________________________________________________________________

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**EXERCISE**

**DIRECTIONS** Solve the following decimal multiplication problems.

| Example: | | |
|---|---|---|
| | 16.11 | 2 Decimal places |
| | x 2.2 | 1 Decimal place |
| | 3222 | |
| | 3222 | |
| | 35.442 | 3 Decimal places in answer |

a. Set up each of the following problems in column form and multiply. Locate the decimal point in the answer.

1. 2.64 x 3.1 = ________

2. 120 x 0.33 = ________

3. 2.25 x 0.51 = ________

4. 35 x 8.5 = ________

5. 26.4 x 3.8 = __________

6. 7.02 x 0.92 = __________

7. 0.83 x 0.55 = __________

8. 28.2 x 0.9 = __________

9. 0.069 x 0.01 = __________

10. 7.52 x 3.01 = __________

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. A surgeon has discounted the cost of an operation by 25% for surgery employees. By what amount is the price reduced if the original cost was $1349.80?

   ✔ **NOTE:** Twenty-five percent is the same as .25.

   Price reduction = ________________

2. The average cost of supplies for a certain operation is $41.25. During the year, surgery does this operation 150 times. What is the total average cost of supplies?

   Total average cost = ________________

3. What is the total thickness of 7 pieces of silicone if each piece is 0.04 inches thick?

   Total thickness in inches= ________________

4. What is the cost of 15 gallons of Betadine at $1.13 per gallon?

   Cost per gallon = ________________

5. If disposable culture tubes cost $0.78 each, what is the cost of 2 dozen culture tubes?

   Cost = ________________

6. Carmelita cleans and wraps one special type of instrument set. She worked 5.6 hours on Monday, 3.8 hours on Tuesday, 4.4 hours on Wednesday, 2 hours on Thursday, and 6.6 hours on Friday. Using this 5-day period as an average, how many hours would Carmelita work over a 15-day period?

   Hours = ________________

**OBJECTIVE 34**

## Assignment Sheet 13—Divide Decimal Numbers

Name ______________________ Date ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Completed all problems and showed work | _____ |
| • Computed a minimum of 13 of the 15 answers correctly per Assignment Sheet 13 answers | _____ |
| **Overall rating** | _____ |

Evaluator's comments ______________________________

______________________________

______________________________

**EXERCISE**

**DIRECTIONS** Solve the following decimal division problems.

a. Set up each of the following problems in column form and multiply. Locate the decimal point in the answer.

1. 4.5 ÷ 0.5 = ________

2. 4.96 ÷ 0.4 = ________

3. 19.8 ÷ 0.6 = ________

4. 10.71 ÷ 0.07 = ________

5. 0.225 ÷ 0.15 = ________

6. 1.7608 ÷ 0.0062 = ______

7. 0.48 ÷ 0.6 = ________

8. 0.125 ÷ 0.25 = _______

9. 0.9 ÷ 0.003 = ________

10. 1.16 ÷ 2.9 = ________

b. Solve the following word problems. Show your work in the spaces provided. Write your answers on the blanks.

1. What is the approximate cost per scissors if 12 scissors cost $103.68?

   Approximate cost = ______________

2. How many hours did Amanda work if she was paid a total of $681.75 at the rate of $22.50 per hour?

   Total hours = ______________

3. How many jobs can be completed in 21.12 hours if the average job takes .66 hours?

   Number of jobs = ______________

4. The purchasing department spent \$172.80 for equipment. What was the cost per piece if they bought 8 pieces of equally priced equipment?

   Total cost = ______________

5. Purchasing received 114 identical items. The price paid for all of them was \$544.98. How much did one item cost?

   Cost = ______________

Introduction to Surgical Technology
Section D: Pharmacology
Module 1-D: Basic Math

**OBJECTIVE 35**

# Assignment Sheet 14—Convert Fractions and Percentages

Name ______________________________ Date ____________

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**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 54 of the 60 answers correctly per Assignment Sheet 14 answers ______

**Overall rating** ______

Evaluator's comments ______________________________

______________________________

______________________________

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**EXERCISE**

**DIRECTIONS** Solve the conversion problems.

a. Express each of the following fractions as a decimal.

1. 1/8 = ________
2. 1/4 = ________
3. 1/2 = ________
4. 3/4 = ________
5. 5/8 = ________
6. 1/16 = ________
7. 3/32 = ________
8. 7/8 = ________
9. 9/16 = ________
10. 15/16 = ________

b. Express each of the following fractions as a percentage.

1. 1/4 = ____________
2. 1/2 = ____________
3. 7/10 = ____________
4. 3/4 = ____________
5. 2/2 = ____________
6. 1/10 = ____________
7. 7/8 = ____________
8. 5/10 = ____________
9. 1/3 = ____________
10. 5/8 = ____________

c. Match the decimal numbers on the right with their correct equivalent fractions. Write the correct letters in the blanks.

| | | | | |
|---|---|---|---|---|
| _______ | 1. | 5 6/10 | a. | 7.083 |
| _______ | 2. | 1 2/100 | b. | 5.006 |
| _______ | 3. | 87/1000 | c. | 78.3 |
| _______ | 4. | 7 83/1000 | d. | 0.087 |
| _______ | 5. | 5 6/100 | e. | 0.783 |
| _______ | 6. | 5 6/1000 | f. | 87.7 |
| _______ | 7. | 78 3/10 | g. | 5.6 |
| _______ | 8. | 87 7/10 | h. | 102.0 |
| _______ | 9. | 102 | i. | 5.06 |
| _______ | 10. | 783/1000 | j. | 1.02 |

d. Write decimal equivalents for each of the following fractions.

1. 63 $^{9}$/10 = ________
2. 5 $^{93}$/100 = ________
3. 5 $^{93}$/1000 = ________
4. 5 $^{93}$/10000 ________
5. 3 $^{825}$/1000 = ________
6. 38 $^{95}$/100 = ________
7. 38 $^{95}$/1000 = ________
8. 42 $^{3}$/10 = ________
9. 402 $^{3}$/10 = ________
10. 897 $^{97}$/100000 = ________

e. Express each of the following percentages as a fraction. Reduce to the lowest terms.

1. 50% = ________
2. 25% = ________
3. 33 $^{1}$/3% = ________
4. 36% = ________
5. 28% = ________
6. 14 $^{2}$/7% = ________
7. 21% = ________
8. 75% = ________
9. 66 $^{2}$/3% = ________
10. 70% = ________

f. Express each of the following percentages as a decimal.

1. 47% = ____________
2. 15% = ____________
3. 33.3% = __________
4. 62% ____________
5. 75% = ____________
6. 3% = ____________
7. 16.8% =____________
8. 9% = ____________
9. 10% = ____________
10. 50% = ____________

**OBJECTIVE 36**

## Assignment Sheet 15—Solve Percentage Problems

Name ______________________ Date ____________

**Evaluation criteria** **Rating**

- Completed all problems and showed work ______
- Computed a minimum of 25 of the 29 answers correctly per Assignment Sheet 15 answers ______

**Overall rating** ______

Evaluator's comments ______________________

**EXERCISE**

**DIRECTIONS** Calculate the answers to the following percentage problems.

a. What does it mean to say 100 percent of the work is completed? ______________________

b. There are usually 100 scissors in the supply bin. Fourteen of them are missing. What percent of the scissors are missing? ______________

c. If 14 scissors are missing in the above problem, how many are present? ________ What percent is present? ______________

d. There are 100 boxes in a carton. Twenty-five boxes are what percent of the boxes in the carton? ______________

e. There are 100 jobs on the board. Ninety-four have been completed. What percent of the jobs have been completed? ______________

f. If 94 of the jobs in the above problem have been completed, how many have not been? ______________ What percent has not been completed? ______________

g. If 11 percent of the surgery employees are absent, what percent are present? ________________________________________

h. If 6 percent of a certain size of suture is not used, what percent is used? ________

i. If 60 percent of the surgeons have private scrubs, what percent do not have private scrubs? ________________________________________

j. Surgery has several sets of arthroscopes, ten percent are one year old, and forty percent are over one year old. What percent are less than one year old? ________________________________________

k. Surgery has three types of screwdrivers—flat, Phillips, and square. Eighty percent are flat, and fifteen percent are square. What percent are Phillips? ________________

l. Surgery reinvested 22 percent of last year's profit in new supplies: 17 percent for instruments, 15 percent for new tables, and 8 percent for miscellaneous supplies. What percent was left for other things? ____________________________

m. Hyun-lee has finished 75 percent of the job he is doing. What percent does he still have to do? ____________________________________

n. Wendy has completed 40 percent of her training. What percent does she still have to do? ____________________________________

o. If you were told to complete 93 percent of the work, what percent would be left? ________________________________________

p. Solve each of the following percentage problems.

1. 3% of 72 is what number? __________
2. 5% of 18 is what number? __________
3. What number is 33 $^1/_3$% of 96? __________
4. 40% of 125 is what number? __________
5. 68% of 63.5 is what number? __________
6. What number is 12 $^1/_2$% of 140.8? __________
7. What number is 1% of 103? __________
8. What number is 37 $^1/_2$% of 152? __________

9. 50% of 32.8 is what number? __________

10. 7% of 163 is what number? __________

q. Solve the following percentage word problems.

1. There are 20 students in a class. Sixty percent of the students are boys. How many are boys?______________________________

2. One day 5 percent of the 20 surgery employees were on time for work. How many of the workers were on time? ______________________

3. Nancy bought a new pair of work shoes that regularly sold for $120.00 at a sale and saved 20 percent. How much money did she save? ________

4. The number of scrub techs at the national convention this year was 75 percent of what it was last year. Last year there were 800 scrub techs at the convention. How many were there this year? ________________________

**OBJECTIVE 37**

# Assignment Sheet 16—Convert Roman Numerals to Arabic Numerals

Name ______________________________ Date ______________

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**Evaluation criteria** **Rating**

- Completed all problems ______
- Computed a minimum of 8 of 10 answers correctly per Assignment Sheet 16 answers ______

**Overall rating** ______

Evaluator's comments ______________________________________

______________________________________________________

______________________________________________________

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**EXERCISE**

**DIRECTIONS** Convert the following Roman numerals to Arabic numerals.

1. V = __________
2. XI = __________
3. VII = __________
4. LXXX = __________
5. III = __________
6. MI = __________
7. XXXVI = __________
8. XCII = __________
9. XLVII = __________
10. CLXIV = __________

**OBJECTIVE 38**

## Assignment Sheet 17—Read a U.S. Customary Rule

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Student followed directions ______
- Computed a minimum of 34 of 40 answers correctly per Assignment Sheet 17 answers ______

**Overall rating** ______

Evaluator's comments ________________________________________

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**EXERCISE**

Reading fractional measurements on a U.S. customary rule

Note: All rules are read similarly. However, some rules are graduated with more divisions than others. The enlarged rule illustrated in Figure 1 is graduated in sixty-fourths of an inch on the top scale and thirty-seconds of an inch on the bottom scale. The staggered graduations are for halves, quarters, eighths, sixteenths, thirty-seconds, etc.

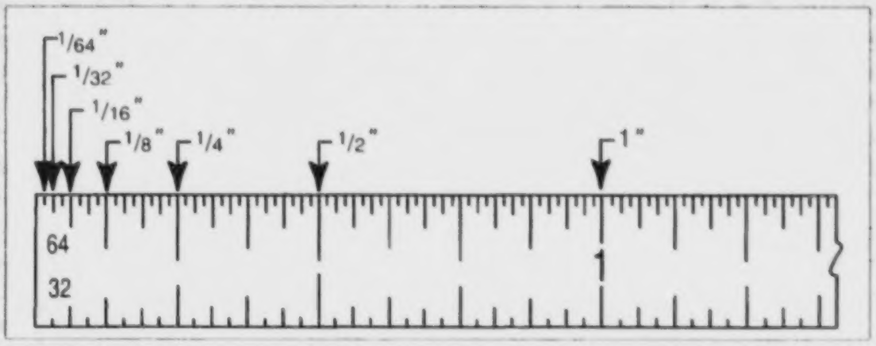

Figure 1

1. Align the end of the rule with one reference point.

2. Determine the number of whole units between the end of the rule and the second reference point (see Figure 2).

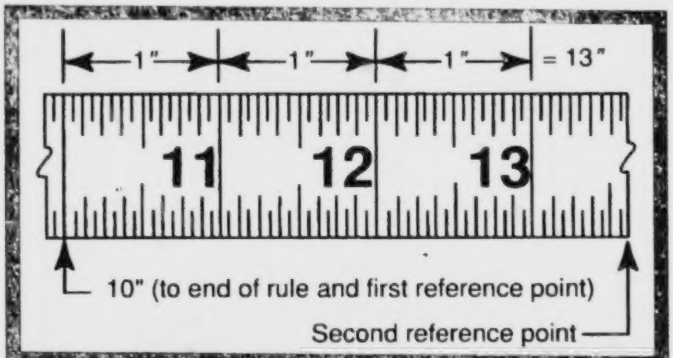
1"
1"
1"
= 13"
11
12
13
10" (to end of rule and first reference point)
Second reference point

Figure 2

3. Determine the number of fractional units between the last whole unit and the second reference point by counting the divisions.

4. Place this number over the rule scale (the rule in Figure 3 below is scaled in sixteenths of an inch) and reduce this fraction if possible.

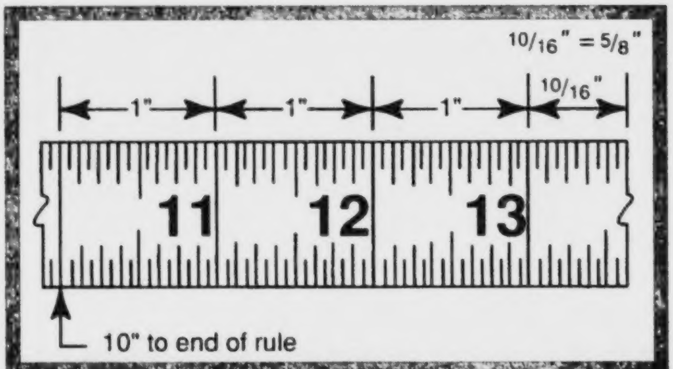
10/16" = 5/8"
10/16"
1"
1"
1"
11
12
13
10" to end of rule

Figure 3

5. Make a mixed fraction by adding this reduced fraction to the number of whole units counted earlier; convert inches to feet if necessary by dividing 12 into the total whole inches measured (see Figure 4).

Example: 3 inches + $^5/_8$ inch = 3 $^5/_8$ inches

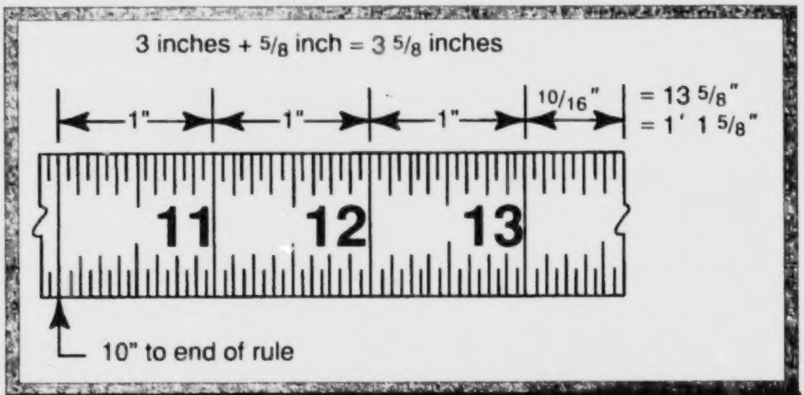
3 inches + 5/8 inch = 3 5/8 inches
1"
1"
1"
10/16"
= 13 5/8"
= 1' 1 5/8"
11
12
13
10" to end of rule

Figure 4

**EXERCISE**

**DIRECTIONS** Write the correct answers on the blanks provided.

a. Read the U.S. customary rule illustrated below to the nearest quarter inch. Write your answers on the blanks provided.

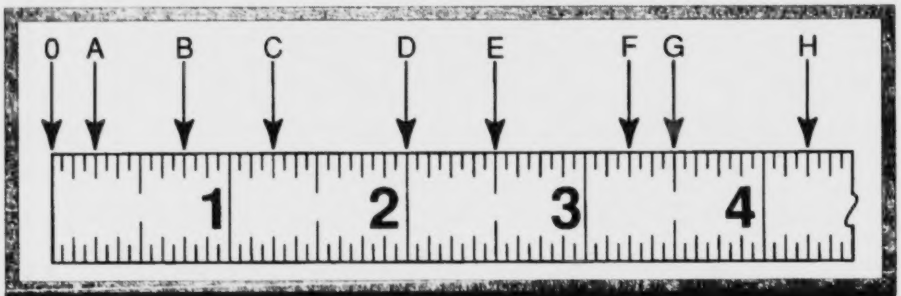
0
A
B
C
D
E
F
G
H
1
2
3
4

Figure 5

1. 0 to A = ______________
2. A to B = ______________
3. 0 to C = ______________
4. A to D = ______________
5. B to D = ______________
6. 0 to E = ______________
7. C to E = ______________
8. B to F = ______________
9. D to G = ______________
10. A to H = ______________

b. Read the U.S. customary rule illustrated below to the nearest eighth inch. Write your answers on the blanks provided.

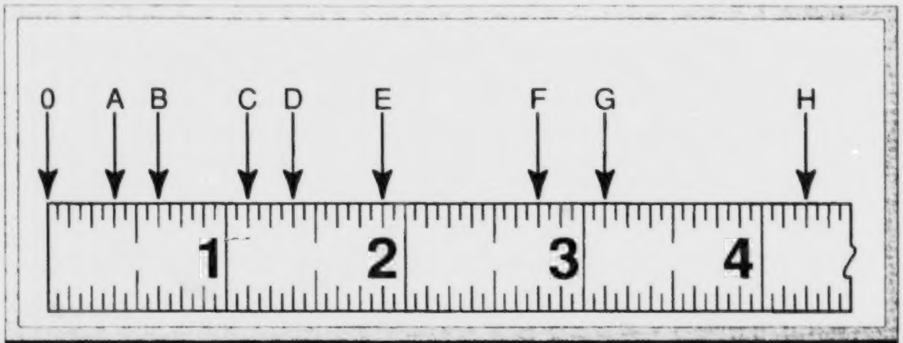

Figure 6

1. 0 to A = ________
2. A to B = ________
3. 0 to C = ________
4. B to D = ________
5. A to E = ________
6. 0 to F = ________
7. D to E = ________
8. C to G = ________
9. 0 to H = ________
10. E to H = ________

c. Read the U.S. customary rule illustrated below to the nearest sixteenth inch. Write your answers on the blanks provided.

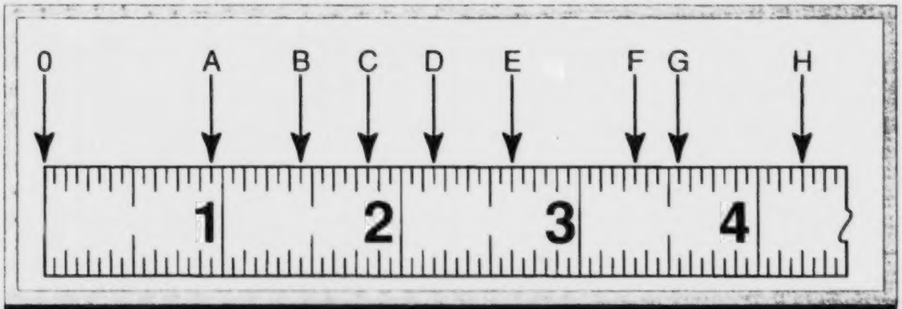

Figure 7

1. 0 to A = ________
2. A to B = ________
3. 0 to C = ________
4. B to D = ________
5. A to E = ________
6. 0 to F = ________
7. C to F = ________
8. A to G = ________
9. 0 to H = ________
10. E to H = ________

d. Read the U.S. customary rule illustrated below to the nearest one thirty-second of an inch. Write your answers on the blanks provided.

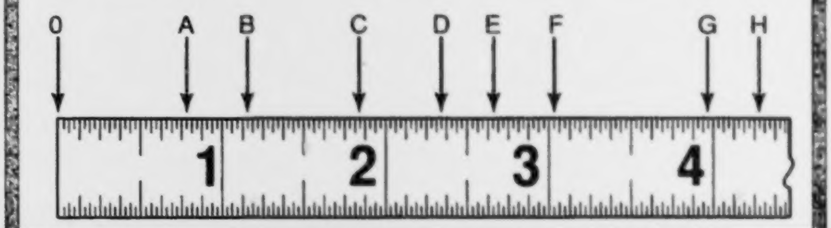

Figure 8

1. 0 to A = ______________
2. 0 to B = ______________
3. A to B = ______________
4. 0 to C = ______________
5. A to D = ______________
6. B to E = ______________
7. C to F = ______________
8. B to G = ______________
9. 0 to H = ______________
10. D to H = ______________

# Introduction to Surgical Technology

## SECTION D: Pharmacology

### Module 2-D: Weights and Measures

## Module Contents

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# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 2-D: Weights and Measures

### Learning Activities Sheet

**PREREQUISITES:** **Module 1-D (optional)**

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 3.

Optional

☐ 5. **Do** Student Supplement 1, "Use Weight Conversion Chart," Student Supplement 2, "Use Capacity Conversion Chart," and Student Supplement 3, "Use Length Conversion Chart."

☐ 6. **Stop** Have your instructor evaluate your performance on Student Supplements 1, 2, and 3, if these optional activities were completed. If the evaluation is satisfactory, continue to step 7. If the evaluation is not satisfactory, repeat step 5.

☐ 7. **Study** Information Sheet, Objective 4 and Objective 5.

☐ 8. **Do** Assignment Sheet 1, "Solve Problems Concerning Metric Equivalents."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat steps 7 and 8.

☐ 10. **Study** Information Sheet, Objective 6.

Optional

☐ 11. **Do** Student Supplement 4, "Use Temperature Conversion Chart."

☐ 12. **Stop** Have your instructor evaluate your performance on Student Supplement 4, if this optional activity was completed. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat step 11.

☐ 13. **Study** Information Sheet, Objective 7.

☐ 14. **Do** Assignment Sheet 2, "Use Abbreviations for Metric Weights and Measures."

☐ 15. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 16. If the evaluation is not satisfactory, repeat step 14.

☐ 16. **Take** Written Test provided by your instructor.

☐ 17. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 18. If the evaluation is not satisfactory, repeat steps 4, 7, 10 and 13.

☐ 18. **Check** With your instructor for any additional assignments to be completed.

☐ 19. **Do** Additional assignments your instructor lists below.

______________________________

______________________________

______________________________

☐ 20. **Take** Module Review provided by your instructor.

☐ 21. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 22. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, student supplements (optional), and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to state metric equivalents for weight, capacity, and length and use metric abbreviations. You should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Select true statements concerning the metric system of measurement.
2. Match metric prefixes with their correct amounts.
3. State metric equivalents of weight, capacity, and length.
4. List advantages of the metric system.
5. State abbreviations for metric weights and measures.
6. Distinguish between systems for measuring temperature.
7. Write the correct abbreviations pertaining to the handling of medications.
8. Solve problems concerning metric equivalents. (Assignment Sheet 1)
9. Use abbreviations for metric weight and measures. (Assignment Sheet 2)

## Information Sheet

OBJECTIVE 1

**Select true statements concerning the metric system of measurement.**

1. **Invented by the French in the late eighteenth century.**
2. **Based on the decimal system; uses units and multiples of tens.**
3. **Uses abbreviations and Arabic numerals for written measurements of medication.**

Examples: Ten grams is written 10 gm.
One thousand milliliters or cubic centimeters is written 1,000 ml. or 1,000 cc.

4. **Basic units of measurement include:**
   - **Meter** for length
   - **Liter** for capacity
   - **Gram** for weight

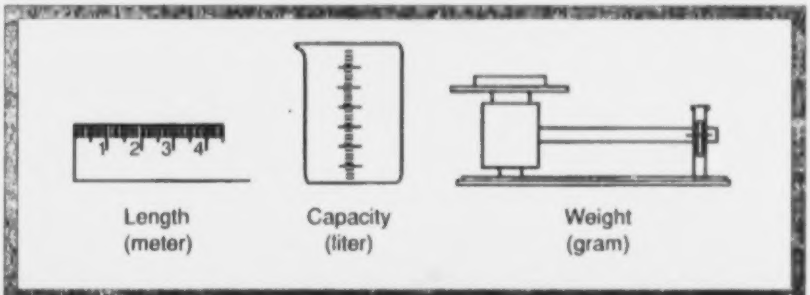


Figure 1 Basic units of measurement

KEY TERMS

**Meter**—Unit of linear measurement in the metric system

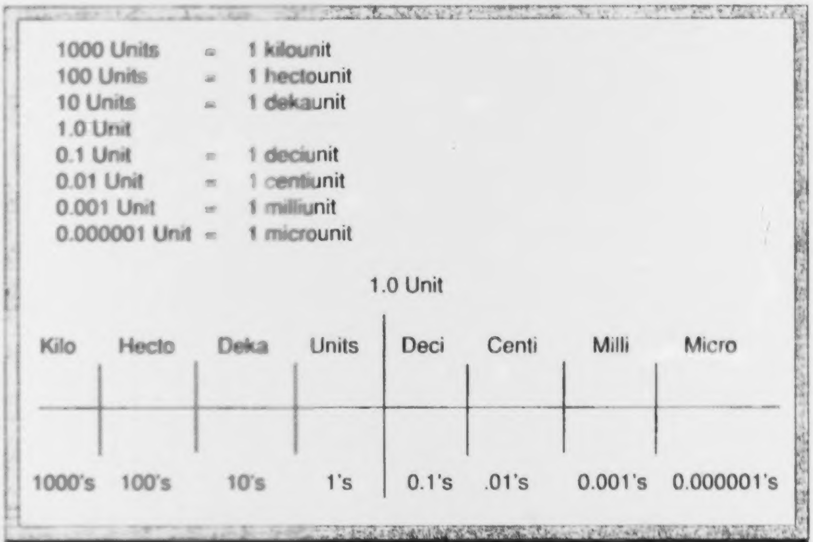
**Liter**—Unit of fluid measurement in the metric system; volume occupied by one kilogram of water at 4° centigrade; slightly more than one quart

**Gram**—Unit of weight in the metric system; weight of one cubic centimeter of water at 4° centigrade

**OBJECTIVE 2**

**Match metric prefixes with their correct amounts.**

1. **Micro**—One-millionth; 0.000001
2. **Milli**—One-thousandth; 0.001
3. **Centi**—One-hundredth; 0.01
4. **Deci**—One-tenth; 0.1
5. **Unit**—One; 1.0
6. **Deka**—Ten; 10.0
7. **Hecto**—One hundred; 100.0
8. **Kilo**—One thousand; 1000.0



1000 Units = 1 kilounit
100 Units = 1 hectounit
10 Units = 1 dekaunit
1.0 Unit
0.1 Unit = 1 deciunit
0.01 Unit = 1 centiunit
0.001 Unit = 1 milliunit
0.000001 Unit = 1 microunit

1.0 Unit
Kilo
Hecto
Deka
Units
Deci
Centi
Milli
Micro
1000's
100's
10's
1's
0.1's
.01's
0.001's
0.000001's

Figure 2

**OBJECTIVE 3**

**State metric equivalents of weight, capacity, and length.**

1. **Weight (gram)**

   - 1 gram = 1000 milligrams

     ✔ **NOTE:** When an amount is less than a gram, it is written in decimal forms of the gram. For example, a dosage is never written as a decigram. Instead it would be expressed as 0.1 gm. An exception to this which is becoming more common is the milligram.

   - 1 kilogram = 1000 grams

- 1 kilogram = 2.2 pounds

✔ **NOTE:** This is used when converting a patient's weight to kilograms.

Example: A patient of 55 pounds weighs 25 kilograms.
55 lbs ÷ 2.2 = 25 kg

- 1 ounce = 30 grams

2. **Capacity (liter)**

- 1 liter = 1000 milliliters
- 1000 liters = 1 kiloliter
- 1 liter = 1.06 quarts
- 1 quart = 0.946 liters

✔ **NOTE:** A liter and a quart may be considered approximately equal, but a quart is slightly smaller than a liter.

- 1 milliliter weighs 1 gram.
- 1 cubic centimeter (cc) and 1 milliliter (ml) are equal in practice.
- 1 liter = 1000 cubic centimeters or milliliters
- 1 fluid ounce = 8 fluid drams = 30 cubic centimeters or milliliters
- 1 fluid dram = 60 minims = 0.125 fluid ounce = 4 cubic centimeters
- 1 gallon = 3.8 liters

3. **Length (meter)**

- 1 meter = 1000 millimeters = 100 centimeters = 1.094 yard
- 1 yard = 3 feet = 36 inches = 0.9144 meters

✔ **NOTE:** A meter and a yard may be considered approximately equal, but a yard is slightly smaller.

- 1 inch = 2.54 centimeters = 25.4 millimeters

✔ **NOTE:** Centimeters and millimeters are often used in the measurement of body organs.

- 1 micron (micrometer) = .001 millimeter = .000001 meter

✔ **NOTE:** The micron is used in measuring minute distances such as sizes of bacteria.

**OBJECTIVE 4** **List advantages of the metric system.**

1. **All standard units of weight and measurement bear a simple relation to the fundamental unit, the meter.**
2. **The prefixes deci, centi, milli, deka, hecto, and kilo have a numerical significance and have other applications in our language that make them readily understood.**

   Examples: U.S. penny is 1 cent which equals 1/100 of a dollar. Decade consists of 10 years. Decathlon has 10 events.

3. **The uniform decimal scale of relation between the successive units make the use of decimal notation possible.**

**OBJECTIVE 5** **State abbreviations used for metric weights and measures.**

1. **Gram**—gm
2. **Milligram**—mg
3. **Kilogram**—kg
4. **Liter**—L
5. **Milliliter**—mL
6. **Cubic centimeter**—cc
7. **Meter**—m
8. **Millimeter**—mm
9. **Centimeter**—cm

**OBJECTIVE 6** **Distinguish between systems for measuring temperature.**

1. **Fahrenheit (F)**
   - Water freezes at 32°
   - Water boils at 212°
2. **Celsius (centigrade) (C)**
   - Water freezes at 0°
   - Water boils at 100°

**Objective 7** **Write the correct abbreviations pertaining to the handling of medications.**

| ABBREVIATION | MEANING | ABBREVIATION | MEANING |
|---|---|---|---|
| $\overline{\text{aa}}$ | of each | OD | right eye |
| ad | to, up to | OU | both eyes |
| amp | ampule | OS | left eye |
| aq | water | os | mouth |
| aq dest | distilled water | oz | ounce |
| cap | capsule | per | through, by |
| $\overline{\text{c}}$ | with | po, per os | by mouth |
| cc | cubic centimeter | pil | pill |
| comp | compound | pre-op | preoperative |
| DC | discontinue | prn | as needed |
| ext | extract | q | every |
| Fe | iron | qh | every hour |
| Fld or *f* | fluid | qs | quantity sufficient |
| gm | gram | R | rectal |
| gtt | drops | Rx | take |
| H, hypo | hypodermic | $\overline{\text{s}}$ | without |
| h | hour | sc, subcu | subcutaneous |
| IM | intramuscular | sol | solution |
| IV | intravenous | sp | spirit |
| L | liter | $\overline{\text{ss}}$ | one-half |
| liq | liquid | stat | at once |
| mg | milligram | tr, tinc | tincture |
| mL | milliliter | u, U | unit |
| ol | oil | ung | ointment |

Figure 3

## Student Supplement 1—Use Weight Conversion Chart

Name ______________________________ Date ________________

**DIRECTIONS** Use the conversion chart given to calculate the problems below.

| WEIGHT CONVERSION CHART | | |
|---|---|---|
| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU MULTIPLY BY |
| Ounces | Grams (or mL) | 30. |
| Grams (or mL) | Ounces | 0.035 |
| Pounds | Kilograms | 0.45 |
| Kilograms | Pounds | 2.2 |
| Grains | Grams (or mL) | 0.065 |
| Grams (or mL) | Grains | 15. |
| Drams | Grams (or mL) | 4. |
| Grams (or mL) | Drams | 0.257 |
| Grams (or mL) | Milligrams | 1000. |
| Milligrams | Grams (or mL) | 0.001 |

1. 5 drams = ______________________ grams
2. 15 grams = ______________________ drams
3. 12 grams = ______________________ milligrams
4. 5 ounces = ______________________ grams
5. 3 grams = ______________________ grains
6. 144 pounds = ______________________ kilograms
7. 220 pounds = ______________________ kilograms
8. 185 pounds = ______________________ kilograms
9. 62 kilograms = ______________________ pounds
10. 104 kilograms = ______________________ pounds
11. 65 grams = ______________________ ounces
12. 120 milligrams = ______________________ grams
13. 70 kilograms = ______________________ pounds

## Student Supplement 2—Use Capacity Conversion Chart

Name __________________________ Date ______________

**DIRECTIONS** Use the conversion chart given to calculate the problems below.

**CAPACITY CONVERSION CHART**

| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU MULTIPLY BY |
|---|---|---|
| Liters | Gallons | 0.26 |
| Gallons | Liters | 3.8 |
| Liters | Quarts | 1.06 |
| Quarts | Liters | 0.95 |
| Liters | Pints | 2.1 |
| Pints | Liters | 0.47 |
| Fluid ounces | Milliliters (or cc) | 30. |
| Milliliters (or cc) | Fluid ounces | 0.034 |
| Minims | Milliliters (or cc) | 0.06 |
| Milliliters (or cc) | Minims | 16.7 |
| Fluid ounces | Fluid drams | 8.0 |
| Fluid drams | Fluid ounces | 0.125 |
| Fluid drams | Milliliters (or cc) | 4. |
| Milliliters (or cc) | Fluid drams | 0.27 |
| Liter | Milliliter (or cc) | 1000. |
| Milliliter | Liter | 0.001 |

1. 12 fluid ounces = __________________ milliliters

2. 2 fluid ounces = __________________ fluid drams

3. 5 liters = __________________ pints

4. .5 liters = __________________ milliliters

5. 7 fluid drams = __________________ cubic centimeters

6. 5 fluid drams = __________________ cubic centimeters

7. 20 milliliters = __________________ fluid ounces

8. 3 cubic centimeter = __________________ fluid drams

9. 2 fluid drams = __________________ cubic centimeters

10. .5 fluid drams = __________________ cubic centimeters

11. 2 liters = __________________ gallons

12. 5 quarts = __________________ liters

13. 3 gallons = ______________________________ liters

14. 7 liters = ______________________________ quarts

15. 700 mL = ______________________________ liter

16. 2 liters = ______________________________ pints

## Student Supplement 3—Use Length Conversion Chart

Name ______________________ Date ____________

**DIRECTIONS** Use the conversion chart given to calculate the problems below.

**LENGTH CONVERSION CHART**

| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU MULTIPLY BY |
|---|---|---|
| Inches | Millimeters | 25.4 |
| Millimeters | Inches | 0.04 |
| Inches | Centimeters | 2.54 |
| Centimeters | Inches | 0.4 |
| Inches | Meters | 0.0254 |
| Meters | Inches | 39.37 |
| Feet | Meters | 0.305 |
| Meters | Feet | 3.28 |
| Meters | Centimeters | 100. |
| Meters | Millimeters | 1000. |
| Millimeters | Meters | 0.001 |
| Millimeters | Centimeters | 0.01 |
| Centimeters | Meters | 0.01 |
| Centimeters | Millimeters | 10. |

1. 12 m = ______________________ "
2. .5′ = ______________________ m
3. 4″ = ______________________ mm
4. 80 mm = ______________________ "
5. 10′ = ______________________ m
6. 5′ 6″ = ______________________ m
7. 6′ 0″ = ______________________ m
8. 1.8034 m = ______________________ "
9. 3′ 4″ = ______________________ m
10. 6′ 2″ = ______________________ m

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## Student Supplement 4—Use Temperature Conversion Chart

Name ______________________________ Date ______________

**DIRECTIONS** Use the conversion chart given to calculate the problems below.

| TEMPERATURE CONVERSION CHART | | |
|---|---|---|
| WHEN YOU KNOW | YOU CAN CONVERT TO | WHEN YOU USE |
| Degrees Fahrenheit | Degrees Celsius | 5/9 (F° −32) = C° |
| Degrees Celsius | Degrees Fahrenheit | 9/5 (C°) +32 = F° |

1. 12°C = ______________________ °F
2. 30°C = ______________________ °F
3. 107°C = ______________________ °F
4. 0°C = ______________________ °F
5. 5°C = ______________________ °F
6. 80°F = ______________________ °C
7. 100°F = ______________________ °C
8. 32°F = ______________________ °C
9. 59°F = ______________________ °C
10. 102°F = ______________________ °C

**OBJECTIVE 8**

## Assignment Sheet 1—Solve Problems Concerning Metric Equivalents

Name ______________________ Date ______________

**Evaluation criteria** **Rating**

- Numbers are expressed as whole and decimal ______
- Problems are correctly solved ______

**Overall rating** ______

Evaluator's comments ______________________

**EXERCISE**

**DIRECTIONS** Solve the following problems of metric equivalents.

1. 1 kilogram = ______________ pounds
2. 1 gram = ______________ milligrams
3. 1 gram = ______________ grains
4. 0.75 gram = ______________ milligrams
5. 0.01 gram = ______________ milligrams
6. 0.5 gram = ______________ milligrams
7. 100 milligrams = ______________ grams
8. 25 milligrams = ______________ grams
9. 15 (or 15.4) grains = ______________ grams
10. 1 grain = ______________ grams
11. 1 grain = ______________ milligrams

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12. 1 ounce = ______________________ grams

13. 50 kilograms = ______________________ pounds

14. 100 kilograms = ______________________ pounds

15. 2 grams = ______________________ grains

CAPACITY

16. 1 cubic centimeter = ______________________ milliliter

17. 15 milliliters = ______________________ cubic centimeters

18. 1 fluid ounce = ______________________ cubic centimeters

19. 1 fluid ounce = ______________________ fluid drams

20. 1 fluid dram = ______________________ milliliters

21. 1 liter = ______________________ cubic centimeters

22. 1 liter = ______________________ quarts

23. 500 liters = ______________________ kiloliters

24. .75 liter = ______________________ cubic centimeters

25. 60 cubic centimeters = ______________________ fluid ounces

LENGTH

26. 100 centimeters = ______________________ millimeters

27. 1 inch = ______________________ centimeters

28. 60 inches = ______________________ centimeters

29. 100 microns = ______________________ millimeters

30. 10 meters = ______________________ centimeters

31. 70 inches = ______________________ meters

32. 1 meter = ______________________ millimeters

33. 1 foot = ______________________ inches

34. 2 feet = ______________________ meters

**OBJECTIVE 9**

## Assignment Sheet 2—Use Abbreviations for Metric Weights and Measures

Name ______________________ Date ____________

---

**Evaluation criteria** **Rating**

- Numbers are expressed as whole and decimal ______
- Abbreviations are correct ______

**Overall rating** ______

Evaluator's comments ______________________________

---

**EXERCISE**

**DIRECTIONS** Write the abbreviations for the following metric weights and measures.

1. Five hundred and twenty-two grams ______________
2. Fifteen milligrams ______________
3. Twelve and one-half cubic centimeters ______________
4. Two and a half grams ______________
5. One hundred and fifty kilograms ______________
6. Six meters ______________
7. Two liters ______________
8. Five centimeters ______________
9. Twenty-five millimeters ______________
10. One gram ______________

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# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

## Module 3-D: Syringes and Hypodermic Needles

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 3-D: Syringes and Hypodermic Needles

## Module Contents

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1—Fill an Irrigating Syringe . . . . . . . . . . 21
2—Draw Up Medication Held By Circulator . . . . . . . . . . 25

# Introduction to Surgical Technology
# Section D: Pharmacology
# Module 3-D: Syringes and Hypodermic Needles

**PREREQUISITES:** None

## Learning Activities Sheet

Student name ______________________________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 3.

☐ 5. **Research** Online resources to learn more about syringes and hypodermic needles. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________
- ______________________________________________

☐ 6. **Do** Assignment Sheet 1, "Read Syringe Calibrations."

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 4 and 6.

☐ 8. **Study** Information Sheet, Objective 4 through Objective 6.

☐ 9. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 10. **Do** Job Sheet 1, "Fill an Irrigating Syringe."

☐ 11. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 12. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat steps 8, 9, 10, and 11.

☐ 12. **Study** Information Sheet, Objective 7 through Objective 9.

☐ 13. **Observe** Demonstration of procedures to be used in completing Job Sheet 2.

☐ 14. **Do** Job Sheet 2, "Draw Up Medication Held By Circulator."

☐ 15. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 16. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat steps 12, 13, 14, and 15.

☐ 16. **Study** Information Sheet, Objective 10.

☐ 17. **Take** Written Test provided by your instructor.

☐ 18. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 19. If the evaluation is not satisfactory, repeat steps 4, 8, 12, and 16.

☐ 19. **Check** With your instructor for any additional assignments to be completed.

☐ 20. **Do** Additional assignments your instructor lists below.

________________________________________

________________________________________

________________________________________

☐ 21. **Take** Module Review provided by your instructor.

☐ 22. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 23. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheet, job sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions

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## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to distinguish between types of syringes and their uses, and demonstrate the ability to fill an irrigating syringe, draw up medication, and receive medication onto the sterile field. You should demonstrate these competencies by completing the assignment sheet and job sheets and by scoring 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Discuss uses for syringes in the operating room.
2. Select the true statements concerning the characteristics of syringes.
3. Identify the parts of a syringe.
4. Complete statements concerning types of syringes used for irrigating.
5. Identify the types of syringes used for injecting and aspirating.
6. Distinguish between the types of syringe tips used for injecting and aspirating.
7. Select true statements concerning the characteristics of hypodermic needles.
8. Identify the parts of a hypodermic needle.
9. Complete statements concerning the care and handling of syringes and hypodermic needles.
10. Select true statements concerning the Occupational Safety and Health Administration (OSHA) regulations concerning the care and handling of sharps.
11. Read syringe calibrations. (Assignment Sheet 1)
12. Fill an irrigating syringe. (Job Sheet 1)
13. Draw up medication held by circulator. (Job Sheet 2)

## Information Sheet

OBJECTIVE 1

**Discuss uses for syringes in the operating room.**

1. **For injection of medications or local anesthesia**
2. **For aspiration of body fluids**

   Example: Aspiration of **synovial fluid** from a swollen knee joint

3. **For irrigation of surgical wounds**

   ✓ **NOTE:** Traumatic wounds may be irrigated gently with warm, sterile saline to remove and dislodge debris and microorganisms.

KEY TERM

**Synovial fluid**—A clear viscid lubricating fluid secreted by the synovial membrane of a joint

OBJECTIVE 2

**Select the true statements concerning the characteristics of syringes.**

1. **Most basic syringes are *calibrated* in cubic centimeters (cc).**

   ✓ **NOTE:** Syringes used to administer insulin are calibrated in units. You will study more about insulin syringes in Objective 5.

2. **Syringes are available in a variety of sizes ranging from 1 cc to 100 cc.**
3. **Syringes are made of two basic materials:**
   - Plastic—Disposable
   - Glass—Reusable

   ✓ **NOTE:** Most medical facilities use sterile disposable syringes, although reusable glass syringes can be used for special procedures or per the surgeon's preference.

4. **Syringes for irrigation are used without needles.**
5. **Syringes for injection of medications or aspiration of fluids are used with various sizes of needles.**

KEY TERM

**Calibrated**—Graduated to indicate a certain value

**OBJECTIVE 3** **Identify the parts of a syringe.**

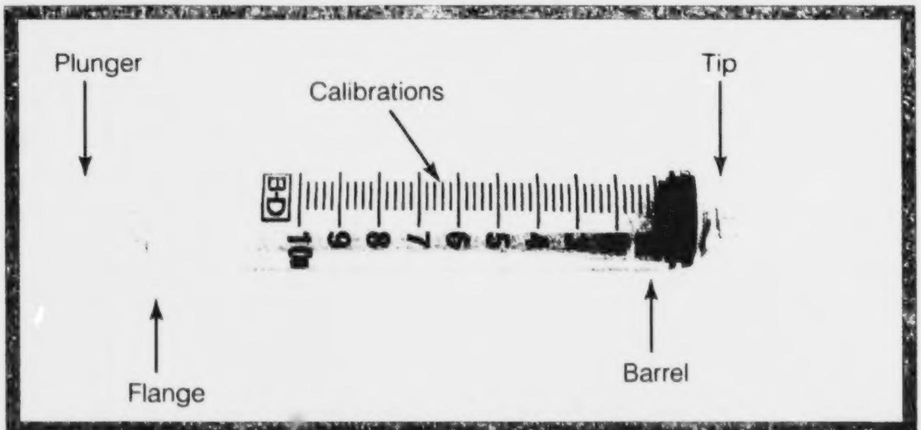

Figure 1
Parts of a syringe

**OBJECTIVE 4** **Complete statements concerning the types of syringes used for irrigation.**

✔ **NOTE:** Irrigating syringes may be one-piece with a bulb or two-piece with a bulb and a removable **barrel**.

1. **Bulb syringe with removable barrel (two-piece)**

   - Is made of plastic or rubber bulb attached to a tapered or blunt end barrel
   - Is made of plastic barrel if disposable or of glass barrel if reusable
   - Is used with one-hand control for irrigation during *many* types of surgical procedures
   - Are available in various capacity sizes; largest holds approximately 120 cc of irrigating solution

   Example: An Asepto® is an example of a bulb syringe with a removable barrel.

Figure 2
Asepto syringe (two piece)

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Example: A Toomey evacuating syringe is an example of a two-piece bulb syringe, which is useful in the irrigation of the bladder and urethra, gastric sampling, and the inflation of foley catheters during a cystoscopy. A Toomey syringe may have a glass barrel if reusable or a plastic barrel if disposable.

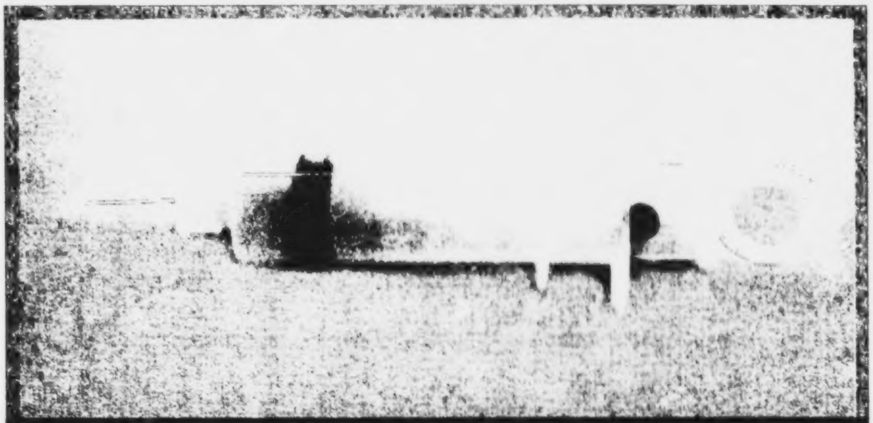

Figure 3
Toomey syringe

2. **Bulb syringe without barrel (one-piece)**

✔ **NOTE:** A bulb syringe without a barrel is usually disposable, because it is difficult to clean the interior of the bulb after use.

- Are made of rubber and taper to a blunt end
- Are used to irrigate small structures such as the ear
- Are used for suctioning nasal and oral fluids from newborns during deliveries by **cesarean section**

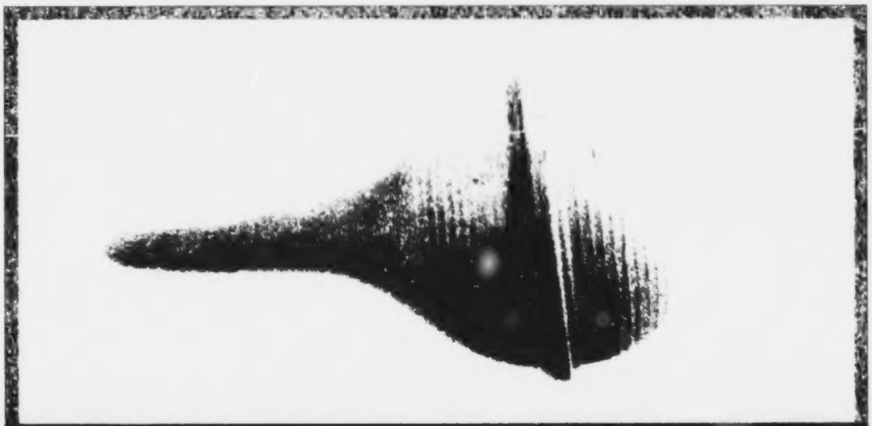

Figure 4
Bulb syringe without barrel (one-piece)

KEY TERMS

**Barrel**—Cylindrical part of a syringe used to hold and measure the syringe's content (solution or medication)

**Cesarean section**—Delivery of the fetus by means of an incision made into the uterus

OBJECTIVE 5

**Identify the types of syringes used for injecting and aspirating.**

1. **Standard**

- Most frequently used for **subcutaneous** or **intramuscular** injections
- Calibrated in cubic centimeters (cc) and tenths (0.1) of a cubic centimeter
- Most common sizes range from 2 1/2 cc to 60 cc
- Larger syringes are often used for aspiration of body fluids and **intravenous** injections.

✔ **NOTE:** The most common size of syringe used in surgery is a 10 cc, which is used in the administration of local anesthesia and the injection of various drugs.

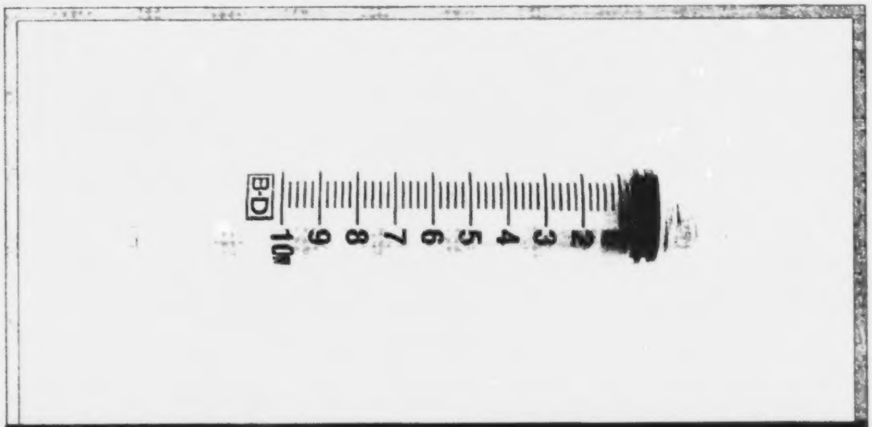

**Figure 5**
**Standard 10cc syringe**

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KEY TERMS

**Subcutaneous**—Beneath the skin

**Intramuscular**—Within a muscle

**Intravenous**—Within or into a vein

## 2. Control

- Control syringes are used for aspiration and the administration of many medications.
- They are calibrated in cubic centimeters (cc) and tenths of a cubic centimeter.
- The barrel has two finger rings and the plunger has a thumb ring to allow the surgeon to have a sure grip when injecting with one hand.
- Disposable sizes range from 12 cc to 20 cc.
- Reusable sizes range from 3 cc to 20 cc.

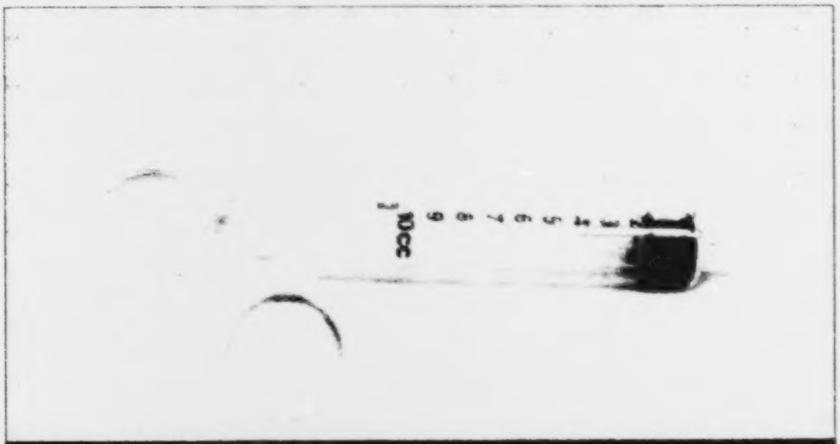

**Figure 6**
**Control syringe**

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3. **Insulin**

- Insulin syringes are specially designed for the administration of insulin only.
- They are calibrated in units and have a 1 cc capacity.

✔ **NOTE:** The syringe used in giving insulin must be marked to correlate with the strength of insulin being used. The insulin syringe must be marked U 100 to match the insulin used. At this time, the use of only one strength of insulin, U 100, is recommended in order to prevent miscalculations, overdosages, and underdosages of insulin.

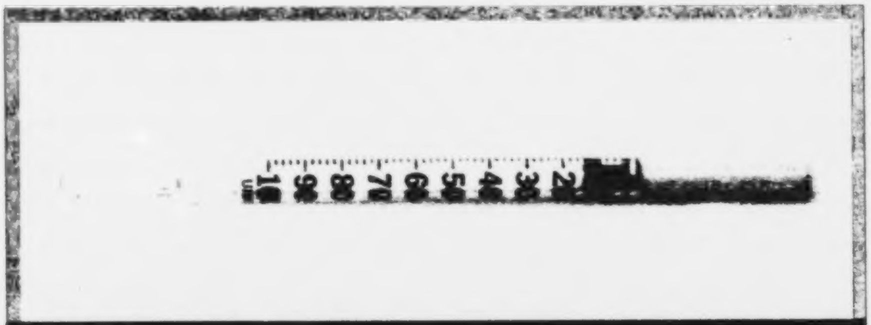

Figure 7
Insulin syringe

4. **Tuberculin**

- Tuberculin syringes are used for intradermal or subcutaneous injections of medication doses less than 1 cc.
- They are calibrated in tenths (0.1) and hundredths (0.01) of a cubic centimeter and hold only a total of 1 cc.
- Very precise amounts of a solution may be measured with a tuberculin syringe. It is commonly used for newborns and pediatric dosages and **intradermal** skin tests.

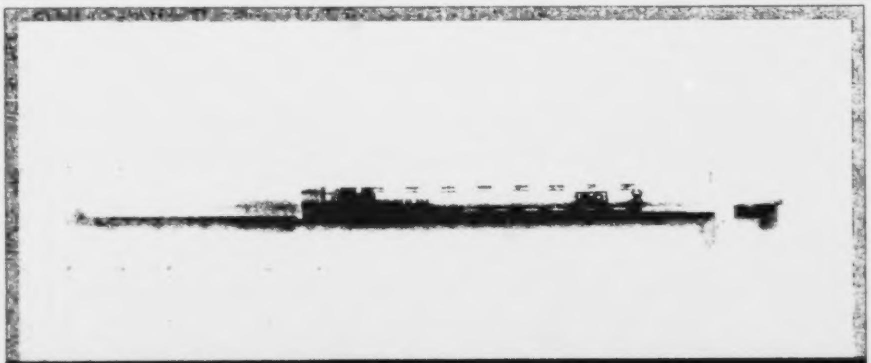

Figure 8
Tuberculin syringe

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### 6. Tubex syringe

- A tubex syringe has a metal or plastic device used to accommodate a **carpule** of medications.
- The carpule has a preattached needle and a rubber stopper that is securely locked into the tubex syringe before administration of medication.
- The carpule is removed from the reusable tubex and disposed of after each use.

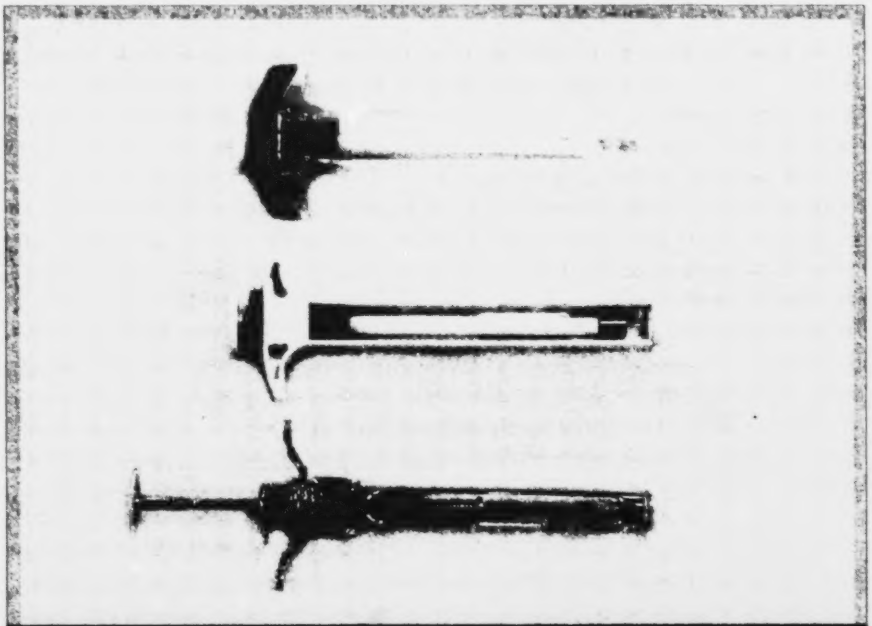

Figure 9
Tubex syringes

KEY TERMS

**Intradermal**—Within the dermis

**Carpule**—Premeasured amount of medication contained in a disposable cartridge with a needle attached

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OBJECTIVE 6 **Distinguish between types of syringe tips used for injecting and aspirating.**

1. **Luer-Lok tip**
    - Has a screw-like mechanism that securely locks over the needle hub
    - Is used whenever pressure needs to be exerted for injection or aspiration

    ✔ **NOTE:** The luer-lok syringe is attached to the needle hub by using a twisting motion to lock the needle to the syringe.

2. **Plain (slip) tip**
    - Has a plain tip that slips over the needle hub
    - May not provide a secure connection
    - Is used with some catheter adapters and rubber connections for aspiration

OBJECTIVE 7 **Select true statements concerning hypodermic needles.**

1. ***Hypodermic* needles may be used to withdraw medication from a *vial*, to inject medication into tissue, or to withdraw body fluids.**
2. **Most needles used in the operating room are disposable and the hub is color-coded by size.**
3. **The diameter of hypodermic needles is indicated by a *gauge* number, which means the diameter of the needle, and ranging from size 12 to 30.**

KEY TERMS

**Hypodermic**—Under or beneath the skin

**Vial**—A small glass bottle containing medication

**Gauge**—Diameter of a slender object such as a wire or hypodermic needle

4. **Small hypodermic needles have larger gauge numbers.**

    Example: A 27-gauge needle is an example of a small needle.

5. **Larger hypodermic needles have smaller gauge numbers.**

    Example: A 12-gauge needle is an example of a large hypodermic needle.

6. **The larger the diameter of needle, the smaller the gauge; the smaller the diameter of needle, the larger the gauge.**

    Example: A 27-gauge needle is smaller than a 12-gauge needle.

7. **Fourteen- to eighteen-gauge needles may be used for aspiration of body fluids and the transfusion of blood or blood components.**

8. **Needles range in length from 3/8″ to 5″.**

9. **Small, short needles are used for intradermal or subcutaneous injections.**

   Example: A 27-gauge 3/8″ needle is used for intradermal local anesthesia and a 25-gauge 5/8″ needle is used for a subcutaneous injection.

10. **Longer needles of medium gauge are used for intravenous or intramuscular injections.**

    Example: A 22-gauge 1 ″ needle is used for an intramuscular injection.

11. **Extra long needles may be used for entering a body cavity.**

    Example: An 18-gauge 2″ needle may be used for an aspiration of a knee joint.

12. **Spinal needles are long, 3″–4″ needles that have a *stylet* with a sharp *bevel*ed tip, which fits through a *cannula* that locks into place to prevent leakage of spinal fluid.**

    ✓ **NOTE:** Spinal needles are used to administer anesthetic agents into the **epidural** or **subdural** space.

13. **Filter needles are available for aspiration of solutions from an *ampule*.**

    ✓ **NOTE:** Before solution is injected, the filter needle is removed from the syringe and replaced with a standard needle.

14. **Heparin needles are used during cardiovascular procedures to irrigate vessels with heparinized saline.**

KEY TERMS

**Stylet**—A thin wire inserted into a catheter to maintain rigidity or into a hollow needle to maintain patency

**Bevel**—Slant or incline that one surface makes with another when not at right (90°) angles; used when referring to the point of a hypodermic needle

**Cannula**—Small tube for insertion into a body cavity, duct, or vessel

**Epidural**—Located over or on the dura

**Subdural**—Beneath the dura

**Ampule**—Hermetically sealed, small bulbous glass vessel that holds a solution for a hypodermic injection

**OBJECTIVE 8** **Identify the parts of a hypodermic needle.**

Figure 10

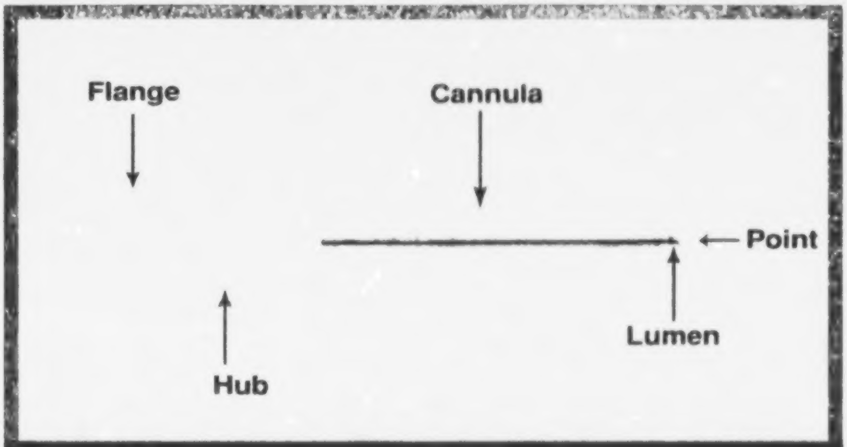


Figure 10
Parts of a hypodermic needle

**OBJECTIVE 9** **Complete statements concerning the care and handling of syringes and hypodermic needles.**

1. **Aseptic technique must be used when handling syringes and needles. The needle, tip, hub, inside of the barrel, and the plunger must be kept sterile.**

2. **Be careful not to touch the plunger except at the end. Any contamination of the plunger will contaminate the solution or medication as the plunger goes down the barrel.**

   ✔ **NOTE:** Glove powder can act as a contaminant and cause a foreign body reaction in the patient.

3. **If two or more syringes of the same type and size are on the sterile field containing different solutions or medications, immediate labeling of the drugs is required to minimize potential for error.**

4. **If the syringe is reusable, the plunger must be removed in order to clean the barrel using pipe cleaners or appropriate brushes.**

5. **For sterilization, the syringe must be lying sideways with plunger removed.**

6. **Care must be taken to determine if the patient is at risk for latex sensitivity.**

   ✔ **NOTE:** Reusable glass syringes or nonlatex syringes are available if the patient is latex sensitive.

7. **If a needle is broken, it must be accounted for in its entirety.**

OBJECTIVE 10

**Select true statements concerning the Occupational Safety and Health Administration (OSHA) regulations concerning the care and handling of sharps.**

✔ **NOTE:** The Occupational Safety and Health Administration (OSHA) regulations of Bloodborne Hazard Standards published in April 2001 is very specific concerning the care and handling of sharp objects. OSHA has made the following rulings concerning contaminated and uncontaminated needles.

1. **Only needles that are uncontaminated may be removed from a syringe.**

   ✔ **NOTE:** Needles that have only entered a medication vial or a clean injection proximal to the patient are considered uncontaminated.

2. **Contaminated needles and other contaminated sharps shall not be bent, recapped, or removed unless the employer can demonstrate that no alternative method is feasible or that such action is required by a specific surgical procedure.**

3. **If bending, recapping, or needle removal is necessary, it must be accomplished by use of a mechanical device or one-handed technique.**

   ✔ **NOTE:** Using a "needle block" or a clamp to recap a needle is considered a mechanical device.

4. **Shearing or breaking of contaminated needles is prohibited.**

5. **Immediately or as soon as possible after use, contaminated reusable sharps must be placed in an appropriate container until properly reprocessed.**

6. **Discard contaminated disposable sharps immediately or as soon as feasible into a color-coded, closable, puncture-resistant, and leak proof biohazard container.**

7. **Always check the hospital's written policy and procedures concerning the handling and disposal of sharps and syringes.**

## Introduction to Surgical Technology
## Section D: Pharmacology
## Module 3-D: Syringes and Hypodermic Needles

**OBJECTIVE 11**

## Assignment Sheet 1—Read Syringe Calibrations

Name ______________________ Date ____________

**Evaluation criterion** **Rating**

- Answers are correct ______

**Overall rating** ______

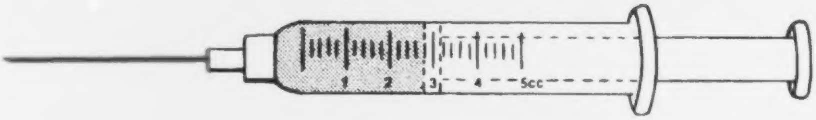
Evaluator's comments ______________________

______________________

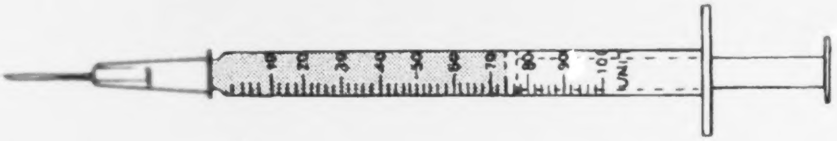
______________________

**EXERCISE**

**DIRECTIONS** Read the following syringe calibrations, and place your answers in the blanks provided.



a. ______________________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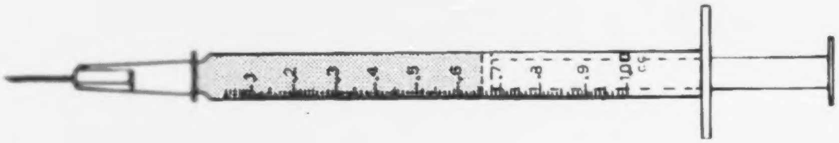
b. ______________________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c ______________________

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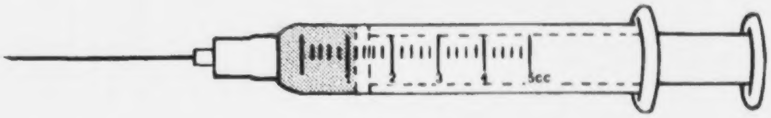
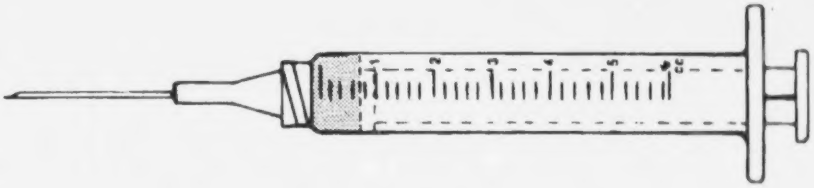


d. ______________________________



e. ______________________________

**OBJECTIVE 12**

# Job Sheet 1—Fill an Irrigating Syringe

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Assembled necessary supplies | ______ |
| • Followed directions | ______ |
| • Performed each step in appropriate sequence | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________________

---

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Irrigating bulb syringe (Asepto®)—120 cc size
- Irrigating solution (saline)—150 cc
- Basin

**PROCEDURE**

✔ **NOTE:** Have your back table and Mayo stand prepared to simulate an actual operating room setting.

☐ 1. Pour the irrigating solution in a basin.

☐ 2. Check the temperature of the solution. It should be warm, not hot.

☐ 3. Depress the bulb.

☐ 4. Submerge the end of the syringe in the solution.

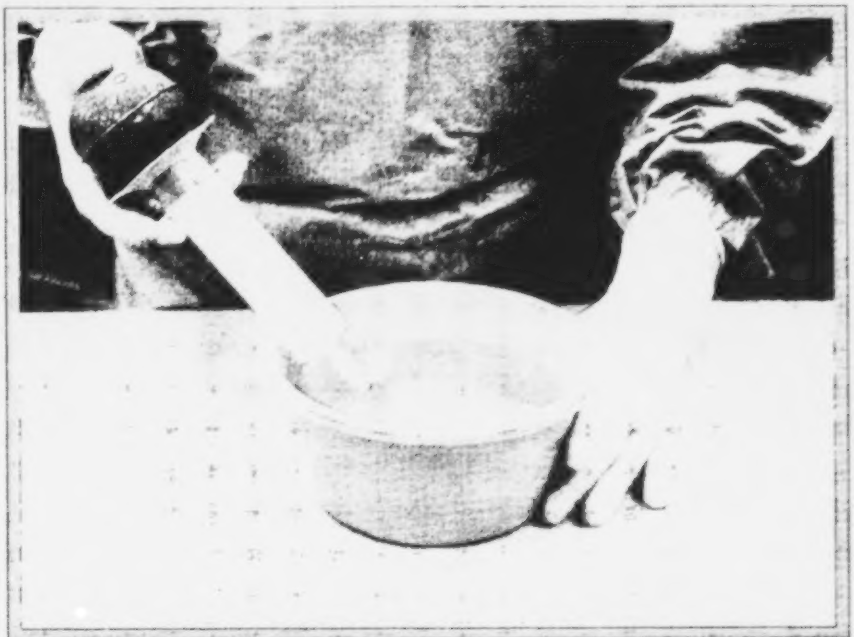


Figure 1

☐ 5. Release the depressed bulb—it will inflate the solution, but not totally.

☐ 6. Tilt syringe tip upwards so air will rise to the top.

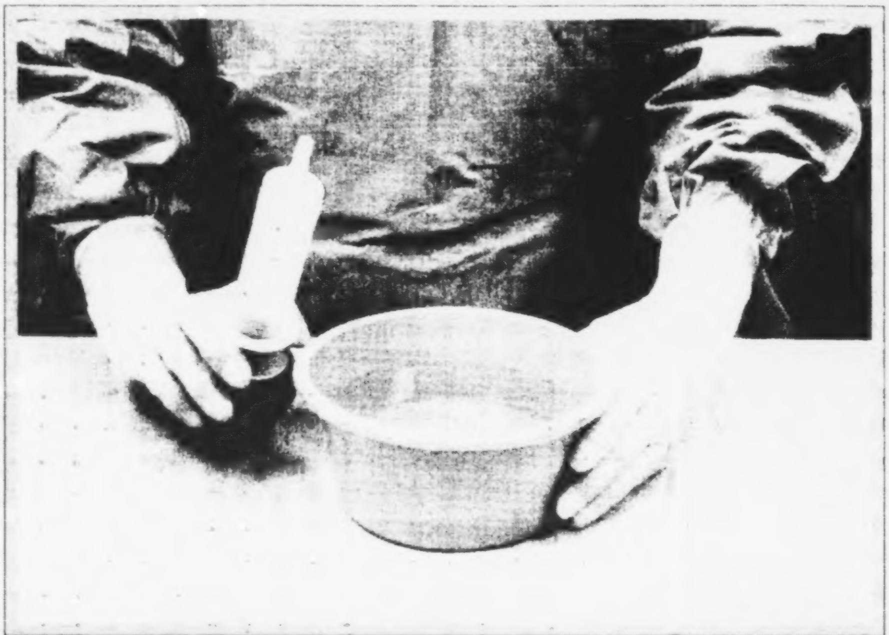


**Figure 2**

☐ 7. Again depress the bulb, submerge its end in the solution, and release to totally fill the bulb to 120 cc.

✔ **NOTE:** The surgical technologist should keep a mental track of the amount of irrigating solution used so that blood loss can be accurately determined.

Evaluator's Comments: ______________________________

______________________________

______________________________

**Objective 13**

## Job Sheet 2—Draw Up Medication Held by a Circulator

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

**Evaluation criteria** **Rating**

- Assembled necessary supplies and equipment ______
- Followed directions ______
- Performed each step in appropriate sequence ______
- Followed aseptic technique ______

**Overall rating** ______

Evaluator's comments ________________________________

---

**Instructions**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**Equipment and materials**

- Standard Luer-Lok syringe
- Appropriately sized hypodermic needle
- Vial of solution or medication
- Disinfectant solution (such as alcohol)
- Cotton balls or sponges
- Clamp
- Circulator
- Scrub person, gowned and gloved

**Procedure**

✔ **NOTE:** Have your back table and Mayo stand prepared to simulate an actual operating room setting.

☐ 1. Assemble syringe.

☐ 2. Place needle on syringe. Check needle for burrs. Discard if defective.

☐ 3. As circulator shows you the vial, verify aloud the name, amount of medication or solution, and expiration date.

☐ 4. As circulator is wiping the rubber stopper with a disinfectant, you can draw air equal to the desired dosage into the syringe.

☐ 5. After circulator inverts the vial, insert needle into rubber stopper.

✔ **NOTE:** As you exert a force for inserting the needle, the circulator will exert an opposing force.

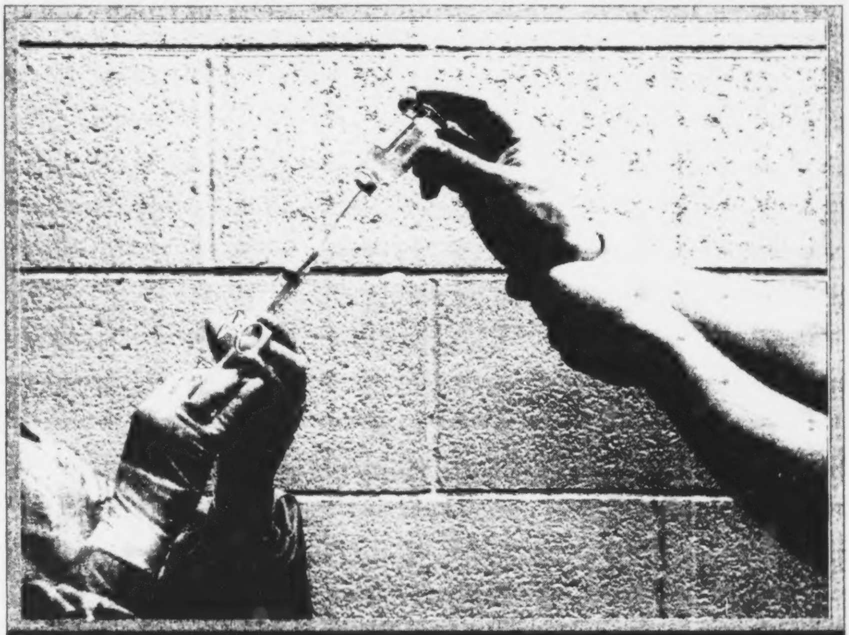


Figure 1

☐ 6. Inject air from syringe into vial.

☐ 7. Withdraw desired amount, making sure needle is below level of solution.

☐ 8. Withdraw needle from rubber stopper.

⚠ **CAUTION:** Do not touch the needle since it is considered unsterile.

☐ 9. Using one of the following methods, hand off the needle to the circulator.

⚠ **CAUTION:** Be careful not to contaminate yourself.

- ☐ a. If the needle has a cap, replace cap, unscrew it, and hand the unsterile needle off field to circulator.
- ☐ b. If the needle has no cap, attach a clamp to the hub of the needle, untwist it, and hand the unsterile needle and clamp off field to circulator.

Evaluator's Comments: ______________________________

______________________________

# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

### Module 4-D: Pharmacologic Agents

## Module Contents

**COMPONENTS**

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2—Use a Drug Information Reference . . . . . . . . . . 39

Job Sheet

1—Receive Medication Onto the Sterile Field . . . . . . . . . . 43

## Introduction to Surgical Technology
## Section D: Pharmacology
## Module 4-D: Pharmacologic Agents

**PREREQUISITES:**
**Module 2-D and Module 3-D**

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 8.

☐ 5. **Research** Online resources to learn more about pharmacologic agents. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Study** Information Sheet, Objective 9 through Objective 22.

☐ 7. **Do** Assignment Sheet 1, "Classify Various Drugs According to Type."

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, repeat steps 6 and 7.

☐ 9. **Study** Information Sheet, Objective 23 and Objective 24.

☐ 10. **Do** Assignment Sheet 2, "Use a Drug Information Reference."

☐ 11. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 12. If the evaluation is not satisfactory, repeat step 10.

☐ 12. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 13. **Do** Job Sheet 1, "Receive Medication Onto the Sterile Field."

| | | | |
|---|---|---|---|
| ☐ | 14. | **Stop** | Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 15. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat steps 12, 13, and 14. |
| ☐ | 15. | **Take** | Written Test provided by your instructor. |
| ☐ | 16. | **Stop** | Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 17. If the evaluation is not satisfactory, repeat steps 4, 6, and 9. |
| ☐ | 17. | **Check** | With your instructor for any additional assignments to be completed. |
| ☐ | 18. | **Do** | Additional assignments your instructor lists below.<br>____________________<br>____________________<br>____________________ |
| ☐ | 19. | **Take** | Module Review provided by your instructor. |
| ☐ | 20. | **Stop** | Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities. |
| ☐ | 21. | **Stop** | Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, job sheet, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions |

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 4-D: Pharmacologic Agents

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to distinguish among the types of drugs and complete statements concerning common drugs used in surgery and the care and handling of medications. You should demonstrate these competencies by completing the assignment sheets and by scoring 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Define *pharmacology*, *pharmacodynamics*, and *pharmacokinetics*.
2. List purposes of drugs.
3. List the types of drug preparations with their correct descriptions.
4. List primary sources of drugs.
5. Distinguish among the types of names that a drug may have.
6. Select common sources of information concerning drugs.
7. Distinguish between the types of drug effects on the human body.
8. Complete statements concerning the route of administration of drugs.
9. Match classifications of common drugs used in surgery with their actions.
10. Select true statements concerning the characteristics of anticoagulants.
11. Complete statements concerning the characteristics of hemostatic agents.
12. Select true statements concerning the characteristics of antibiotic/anti-infectives commonly used in surgery.
13. Complete statements concerning narcotic analgesics.
14. Match drugs used for ophthalmic surgery with their correct uses.
15. Select true statements concerning characteristics of diuretics.
16. Select true statements concerning characteristics of steroids.
17. Complete statements concerning characteristics of hormones.
18. Complete statements concerning characteristics of contrast media.
19. Match common dyes used in surgery with their correct descriptions.
20. Complete statements concerning characteristics of intravenous solutions.

21. Complete statements concerning blood replacements, blood components, and blood substitutes.

22. Match miscellaneous drugs used in surgery for emergency situations with their correct descriptions.

23. Select true statements concerning the care and handling of medications.

24. Complete statements concerning the procedure for the surgical technologist to accept medication from the circulator.

25. Classify various drugs according to type. (Assignment Sheet 1)

26. Use a drug information reference. (Assignment Sheet 2)

27. Receive medication onto the sterile field. (Job Sheet 1)

## Information Sheet

OBJECTIVE 1

**Define *pharmacology*, *pharmacodynamics*, and *pharmacokinetics*.**

1. **Pharmacology**—The study of drugs and their origin, nature, properties, and effect upon living organisms
2. **Pharmacodynamics**—The study of drugs and their actions on living organisms
3. **Pharmacokinetics**—The study of the metabolism and actions of drugs with emphasis on absorption, duration, distribution in the body, and method of excretion

   ✔ **NOTE:** The therapeutic value of drugs on humans dates back to the prehistoric era where treatments for specific conditions were discovered by coincidence.

KEY TERM

**Drugs**—Any chemical substance taken into the body for the purpose of affecting the body's functions

OBJECTIVE 2

**List the purposes of drugs.**

1. **Diagnosis**

   Examples: Drugs such as contrast media are used to outline internal structures in order to detect obstructions, strictures, or abnormalities. You will study contrast media in Objective 18.

2. **Treatment of symptoms**

   Examples: Analgesics to relieve pain, antipyretic to decrease a patient's body temperature, or a local anesthesia to relieve or prevent pain during a surgical procedure

3. **Treatment of diseases or dysfunctions**

   Examples: Antibiotics taken internally for a specific infection, topical ointments applied to the skin for dermatitis, and hormone therapy such as insulin or diabetes mellitus

4. **Prevention of disease**

   Examples: Medications used to prevent disease include Hepatitis B vaccine and antitoxins to prevent tetanus

**OBJECTIVE 3**

**List types of drug preparations.**

1. **Solids**

- Absorbed through the alimentary tract
- Routes of administration can be oral, buccal, or sublingual

✔ **NOTE:** Solid medication is rarely used in surgery because of its oral route of administration.

Examples: Tablets, capsules, lozenges, and powders; Tylenol®, Motrin®, or aspirin

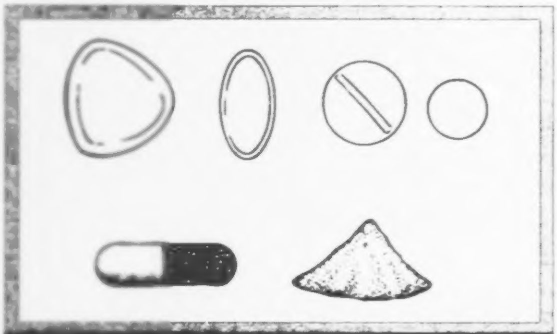

Figure 1
Solids

2. **Semi-solids**

- Are meant to have a topical or systemic effect
- Can be applied directly to skin or mucous membranes to produce the desired effect

Examples: Creams, ointments, gels, dermal patches, and suppositories; Silvadene cream, Betadine ointment and gel, Nicoderm® patches, and Tylenol® suppositories

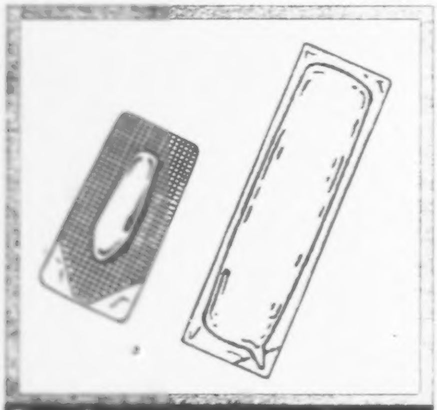

Figure 2
Semi-solids

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### 3. Liquids

- Contain drugs that are dissolved in a base

Examples: **Suspensions**, **emulsions**, **solutions**, **tinctures**, **elixirs**, **syrups**, **liquid sprays**, and **foams**; Maalox® suspension, Betadine solution, tincture of iodine, Tylenol® elixir, and Afrin® nasal spray

**Figure 3**
Liquids

KEY TERMS

**Suspension**—Fine, undissolved solid particles of a drug suspended with a liquid

**Emulsion**—A mixture of two liquids not mutually soluble, such as fat and water

**Solution**—A liquid drug containing a dissolved substance

**Tincture**—A solution that contains an alcohol and water base; used topically

**Elixir**—A sweetened, aromatic solution with an alcohol and water base

**Syrup**—A concentrated solution of sugar, water, and flavoring which contains no alcohol

**Liquid sprays**—A solution of a drug containing water or alcohol administered as an aerosol or spray

**Foam**—A mixture of finely divided gas bubbles interspersed in a liquid

4. **Gases**

- Are introduced into the respiratory tract to provide a systemic effect

Examples: Anesthesia agents such as nitrous oxide, Halothane®, Enflurane®, Isoflurane®, Suprane®, and Sevoflurane®

✔ **NOTE:** You will study the gases utilized in the operating room in Module 5-D: "Anesthesia."

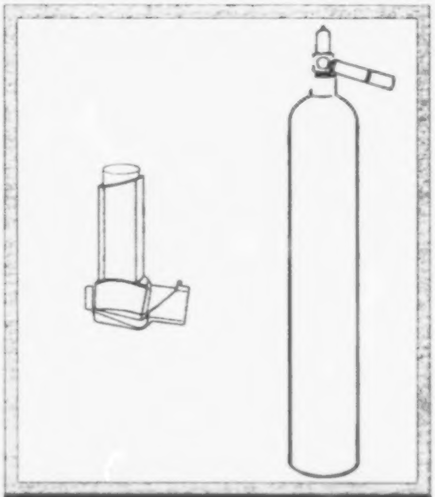

Figure 4
Gases

OBJECTIVE 4 **List the primary sources of drugs.**

1. **Plants**

- Berries, leaves, roots, resin and bark from trees were found to benefit the body and are still in use today.

  Examples: Digitalis obtained from purple foxglove plant, atropine from the root of the belladonna plant, iodine from kelp or seaweed, and morphine and codeine from white poppy

Figure 5
Plants

2. **Minerals**

Examples: Iron, potassium, silver, sulfur, calcium, gold, zinc, and magnesium; iron is used to treat anemia

Figure 6
Minerals

3. **Animals**

- Deficiencies of substances in the human body are often replaced with substance from the glands, organs, and tissues of animals.
- Drugs acquired from cattle are called bovine and those from swine are called porcine.

Examples: Insulin from the pancreas of cows and hogs can be used to treat diabetes.

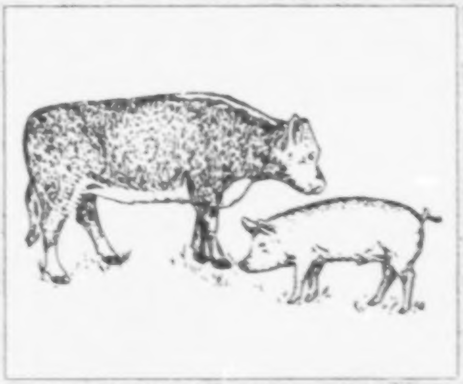

Figure 7
Animals

### 4. Synthetic

- Are manufactured by humans and produced from artificial substances rather than natural substances
- Can be manufactured totally from laboratory chemicals or semi-synthetic drugs
- Can be activated with a natural substance rather than altered chemically

Examples: Antibiotics such as penicillin and streptomycin produced in the laboratory to treat bacterial infections

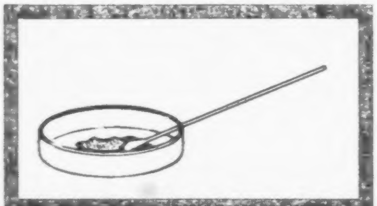

Figure 8
Synthetic

### 5. Biotechnology

- Genetic engineering (recombinant **DNA** technology) is the newest technology being used to synthetically mass produce previously rare and expensive drugs. By introducing unrelated DNA into the DNA of specific organisms, DNA can be artificially created.

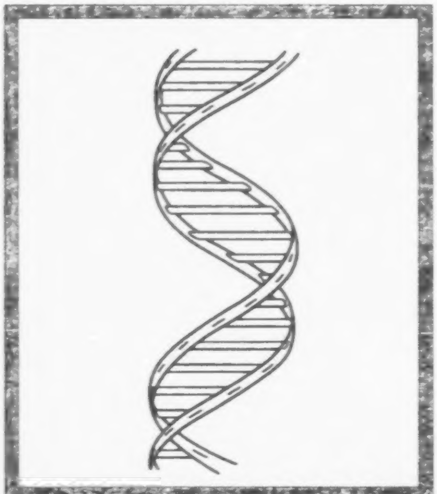

Figure 9
Biotechnology DNA ladder

Examples: Human insulin (Humulin®) and human growth hormone (Nutropin®)

KEY TERM

**DNA** (Deoxyribonucleic Acid)—A distinctive pattern of bands which aid in the identification of the origin of tissue and body fluids

OBJECTIVE 5

**Distinguish among the types of names that a drug may have.**

1. **Chemical name**
    - Exact chemical formula of a drug
    - Usually a long, very difficult name to pronounce and of little concern to the health care worker

    ✔ **NOTE:** The first letter is not capitalized.
2. **Generic name**
    - Common or general name assigned to the drug when it is marketed
    - Differentiated from trade name by initial lowercase letter

    ✔ **NOTE:** The first letter is never capitalized.
3. **Trade name or brand name**
    - Name by which a pharmaceutical company identifies its product; is copyrighted and used exclusively by that company
    - Can be distinguished from generic name by capitalized first letter
    - Symbol ® is used behind the name to indicate it is a "registered" trademark.

OBJECTIVE 6

**Select the common sources of information concerning drugs.**

1. ***Physician's Desk Reference (PDR)***
    - Most widely used annual reference publication for drugs in current use
    - Contains information concerning drug actions, indications, warnings and precautions, dosages, route of administration, adverse reactions, overdose, drug interaction and contraindications
2. ***United States Pharmacopoeia and National Formulary (USP/NF)***
    - Provides information to physicians
    - Is used primarily by drug companies and pharmacies
    - Includes annual up-to-date information on **carcinogens**

3. ***American Hospital Formulary Service Drug Information (AHFS)***

   - Is an annual publication distributed to practicing physicians
   - Contains concise information and is easy to read

KEY TERM

**Carcinogen**—Any substance or agent that produces cancer or increases the risk of developing cancer in humans and animals

OBJECTIVE 7

**Distinguish between the types of drug effects on the human body.**

1. **Systemic**—The effect has the ability to be absorbed and distributed throughout the body to produce a physiological change
2. **Local**—The effect is limited to the area of the body where it is administered

   Example: Lidocaine injected at surgical incision site is limited to the site of administration.

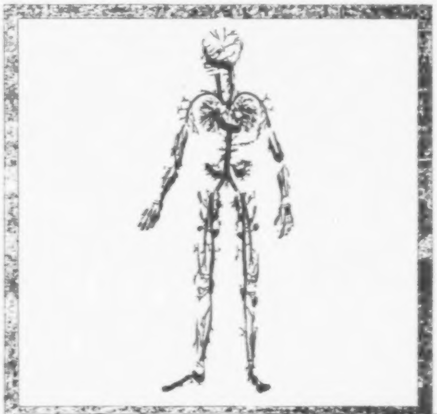

Figure 10
Systemic effect

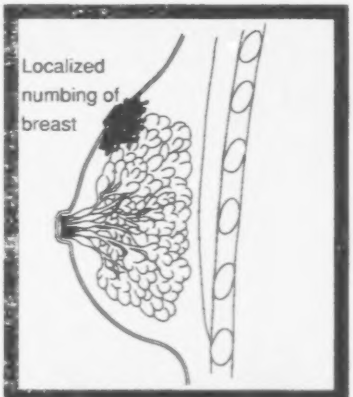

Figure 11
Local effect

OBJECTIVE 8

**Complete statements concerning the route of administration of drugs.**

✔ **NOTE:** All drugs are designed for one or more specific routes of administration. Drugs administered by one route may be therapeutic while given by another may be ineffective, harmful, or even fatal. Certain routes of administration are restricted to surgical application only.

1. **Oral**—Administered through the mouth into gastrointestinal tract

   ✔ **NOTE:** The oral route of administration is the most common and easiest route, but NOT the route of choice for a surgical patient who is NPO.

2. **Buccal**—Placed between the cheek and the gums until absorbed or dissolved
3. **Sublingual**—Placed under the tongue until the drug has been absorbed or dissolved

   ✔ **NOTE:** Buccal and sublingual routes of administration produce a local or systemic effect. An example of a sublingual medication that produces a systemic effect is nitroglycerin which is used to treat chest pain.

4. **Topical**—Applied directly to the skin, mucous membranes of the eyes, ears, nose, or mouth, or on surface of structures in an open surgical wound

   ✔ **NOTE:** Topical medications used in surgery generally provide a local, not a systemic effect and should **NEVER** be injected. Thrombin placed on a bleeding surface to promote hemostasis is an example of a typical route of administration.

5. **Rectal**—Administered via the rectum

   ✔ **NOTE:** Medications administered rectally are slow to absorb and have very unpredictable effects.

6. **Vaginal**—Used for the application of creams and suppositories
7. **Transdermal**—Applied directly to the skin via a porous membrane for a systemic effect
8. **Inhalation**—Involves inhaling a drug in the form of a gas or liquid into the alveoli of the lung

   Examples: Anesthesia gases and bronchodilators delivered by an inhaler to treat asthma

9. **Subcutaneous**—Involves injection of medication into the fatty layer of tissue directly below the dermis of the skin
10. **Intramuscular**—Involves injection of a liquid directly into the muscle

    ✔ **NOTE:** The muscles of the body are well supplied with blood vessels making the absorption of medication faster than subcutaneous tissue which contains fewer blood vessels.

11. **Intravenous**—Involves injection of liquid medication directly into a vein to produce a systemic effect

    ✔ **NOTE:** Immediate absorption of medication into the blood stream occurs when using the intravenous route of administration.

12. **Intra-articular**—Involves injection of a liquid into a joint in the body

    Examples: Cortisone used to treat inflammation of a joint such as arthritis

13. **Intracardiac**—Involves injection of medication directly into the heart

    ✔ **NOTE:** This route is used to inject specific medications during emergency resuscitative measures. An example is the injection of adrenaline directly into chest wall into the heart muscle to stimulate the heart muscle during cardiac arrest.

14. **Intrathecal**—Involves the injection of medication into the subarachnoid space of the spinal canal

    Example: The injection of lidocaine into the subarachnoid space during a spinal block to produce loss of sensation to the portion of the body below the diaphragm. You will study the administration of spinal anesthesia in Module 5-D: "Anesthesia."

OBJECTIVE 9

**Match the classifications of common drugs used in surgery with their actions.**

1. **Adrenergic**—Imitates the action of the sympathetic nervous system by stimulating nerve fibers to release epinephrine
2. **Adrenergic blocker**—Blocks the secretion of epinephrine from the sympathetic nervous system
3. **Analeptic**—Stimulates the central nervous system
4. **Analgesic**—Selectively suppresses pain without producing sedation
5. **Anesthesia**—Produces loss of feeling and elimination of pain
6. **Antibiotic/anti-infective agent**—Destroys bacteria and other **pathogenic** microorganisms
7. **Anticholinergic**—Inhibits the parasympathetic response by manifesting the drying up of body secretions
8. **Anticoagulant**—Prevents the formation of blood clots by inhibiting one or several clotting factors

   ✔ **NOTE:** Anticoagulant drugs are not effective in dissolving clots that have already formed.

9. **Anticonvulsant**—Reduces the number or severity of seizures in patients with epilepsy
10. **Antiemetic**—Used to prevent or treat nausea and vomiting
11. **Antihistamine**—Blocks the effect of **histamine** release in an allergic reaction
12. **Anti-inflammatory**—Decreases the symptoms of inflammation of the musculoskeletal system
13. **Antineoplastic**—Prevents the development, growth, or proliferation of malignant or cancerous cells
14. **Antipyretic**—Reduces fever
15. **Cardiovascular agent**—Acts on the heart and blood vessels
16. **Coagulant**—Promotes and accelerates blood clotting
17. **Diuretic**—Influences the function of the urinary system to increase urine output

18. **Fibrinolytic/Thrombolytic agent**—Used to break down the **fibrin** in a blood clot and prevent the **polymerization** of fibrin in new clots

19. **Hemostatic**—Enhances clot formation and reduces bleeding

20. **Histamine (H2) receptor blocker**—Reduces the amount of gastric acid present in the stomach

    Example: Cimetidine (Tagamet®) and Ranitidine (Zantac®)

21. **Hormone**—Substance originating in an organ or gland which is carried by the bloodstream to its target organ; stimulates organ by chemical action to increase activity or to secrete another hormone

22. **Hypnotic**—Induces sleep and insensibility to pain

23. **Muscle relaxant/neuromuscular blocking agent**—Specifically acts to relieve spasms and stiffness of the skeletal muscles

24. **Narcotic**—Relieves moderate to severe pain, produces sedation, and gives a feeling of euphoria

25. **Oxytocic**—Stimulates uterine contraction and treats postpartum bleeding

26. **Sedative**—Exerts a soothing or tranquilizing effect but does not produce sleep

27. **Tranquilizer**—Used to treat anxiety, anxiousness, or mental tension

28. **Vasoconstrictor**—Has an adrenergic action used to constrict blood vessels

29. **Vasodilator**—Dilates blood vessels

KEY TERMS

**Pathogenic**—Capable of producing disease or infection

**Histamine**—A substance that causes the dilation of blood vessels, mucous production, tissue swelling and itching

**Fibrin**—A stringy insoluble protein produced by the action of thrombin on fibrinogen in the clotting process

**Polymerization**—The process of changing a simple chemical substance into another compound having the same elements usually in the same proportions but with a higher molecular weight

OBJECTIVE 10

**Select true statements concerning the characteristics of anticoagulants.**

1. **Are used to prevent the clotting of blood**
2. **Are used intraoperatively in many types of peripheral and cardiovascular procedures**

3. **Prevent clot formation around vessels when used as an irrigating solution in the surgical wound**

4. **Prevent *thrombosis* when given intravenously to the patient**

5. **Most common parenteral anticoagulant used in surgery is heparin sodium**

6. **Heparin comes in various concentrations.**

   ✔ **NOTE:** Careful attention must be given when identifying the correct dosage of heparin. Heparin can contain 1,000 units, 5,000 units, 10,000 units, or as much as 20,000 units per ml. A heparin dose is determined by the concentration of medication rather than by the quantity of the dosage.

7. **A dilute solution, usually 5,000 units of heparin in 1,000 ml of normal saline, may be used for topical irrigating of the surgical wound.**

8. **The principle postoperative complication of anticoagulant therapy is spontaneous bleeding.**

9. **The antagonist for heparin is protamine sulfate which is kept in the refrigerator.**

   ✔ **NOTE:** Protamine sulfate acts as an anticoagulant when used alone. It may be used to treat heparin overdose or to reverse heparin-induced anticoagulation.

KEY TERM

**Thrombosis**—The abnormal formation or presence of a blood clot in the vascular system

OBJECTIVE 11

**Complete statements concerning the characteristics of hemostatic agents.**

1. **Hemostatic agents are used to promote blood coagulation when bleeding cannot be controlled by the standard methods of hemostasis such as clamping, ligating, applying hemostatic clips, and electrosurgery.**

2. **Hemostatic agents used in surgery are administered systemically or topically in the forms of powders, sponges, solutions, or films.**

3. **Hemostatic agents administered systemically include:**

   - Calcium salts, such as calcium gluconate and calcium chloride, are needed to replace deficiencies in natural clotting mechanism.
   - Vitamin K (Konakion®, Mephyton®, or AquaMephyton®) is needed for normal blood coagulation.

   ✔ **NOTE:** A deficiency of Vitamin K can cause excessive bleeding in the surgical patient.

4. **Systemic hemostatic agents can be administered intravenously, intramuscularly, orally, or subcutaneously depending on the form of the medication.**

5. **Hemostatic agents administered topically include thrombin, bone wax, Gelfilm®, Gelfoam®, Avitene®, Instat MCH®, Surgicel®, Surgicel NuKnit®, Oxycel®, and Helistat®, and chemical hemostatic such as tannic acid and silver nitrate.**

6. **Thrombin**

- Is a dry powder which is dissolved in a sterile saline solution
- Promotes clotting on bleeding surfaces of delicate tissue
- Is applied topically and should **NEVER** be injected
- Should be kept in the refrigerator and used immediately after reconstituting
- May be used in conjunction with other topical hemostatic agents to control surgical bleeding

  Example: Pieces of Gelfoam® soaked in thrombin

- Speed of clotting action depends on the concentration of the solution used; solutions range in concentration from 100 units per milliliter to as high as 2,000 units per milliliter

THROMBIN, TOPICAL
(BOVINE ORIGIN), U.S.P.
THROMBIN-JMI
20,000 U.S. Units
GENTRAC, INC.
FOR TOPICAL USE ONLY DO NOT INJECT
THROMBIN, TOPICAL
(BOVINE ORIGIN), U.S.P.
THROMBIN-JMI
5,000 U.S. Units
JMI

**Figure 12**
**Thrombin**

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7. **Bone wax**

- Is a topical hemostatic agent made of beeswax
- Is packaged in a sterile foil-wrapped package
- Applied directly to the bleeding surfaces of bone
- Is used primarily in neurosurgery and orthopedics to control bleeding by acting as a mechanical barrier

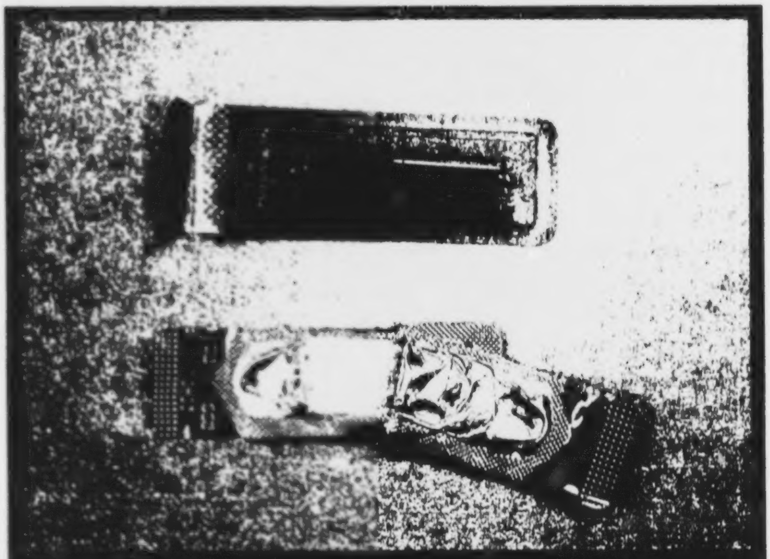

Figure 13
Bonewax

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## 8. Absorbable gelatin hemostatic agents

- Gelfilm®
  - Has a stiff cellophane appearance when dry and has a soft elastic consistency when moistened
  - Acts as a mechanical barrier when applied topically to bleeding surface
  - Is absorbed completely by the tissues in 4 to 6 weeks
  - Is used in neurosurgery, thoracic, and ophthalmic procedures to cover defective tissue and to prevent bleeding

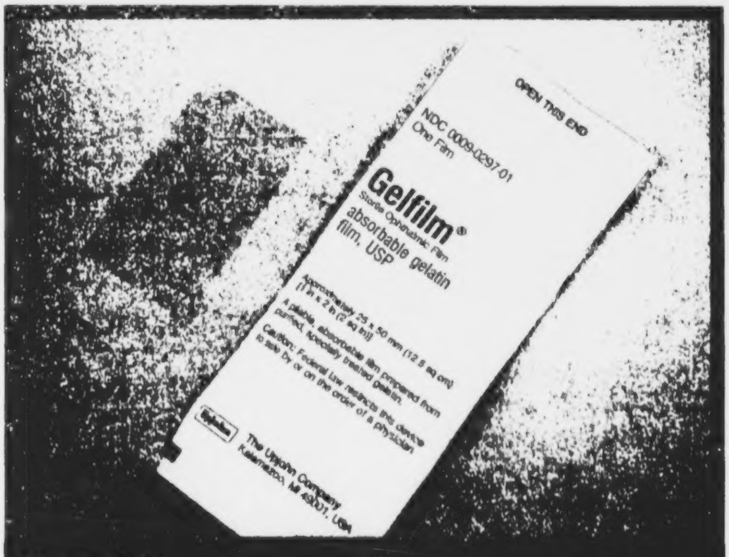
OPEN THIS END
NDC 0009-0297-01
One Film
Gelfilm®
Sterile Ophthalmic Film
absorbable gelatin film, USP
Approximately 25 x 50 mm (12.5 sq cm) (1 in x 2 in (2 sq in))
A pliable, absorbable film prepared from purified, specially treated gelatin.
Caution: Federal law restricts this device to sale by or on the order of a physician
The Upjohn Company
Kalamazoo, MI 49001, USA

Figure 14
Gelfilm

- Gelfoam®
  - Is applied to bleeding tissue to quickly stop the flow of blood
  - Is available in a powder form or an absorbable gelatin sponge form
  - Gelfoam® powder can be made into a paste by mixing with saline.

    ✔ **NOTE:** Powder form may be used on areas of ulceration of the skin due to its ability to promote **granulation** in tissue.
  - Sponge forms are available in various sizes; may be cut to desired size or shape depending on the application
  - Sponge form may be moistened with saline, thrombin, or epinephrine solution before it is placed on a bleeding surface.
  - Gelfoam® can be left in the surgical wound, and is completely absorbed in 4–6 weeks.

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- Gelfoam® is commonly used in general, orthopedic, and neurosurgical procedures.

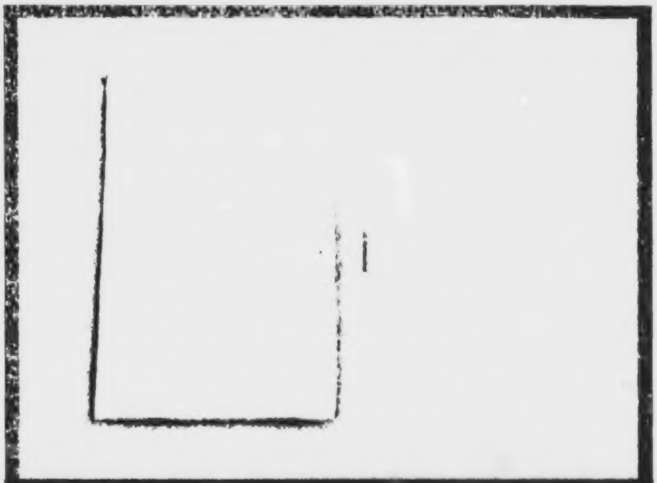

Figure 15
Gelfoam

9. *Microfibrillar* collagen hemostatic agents

- Avitene®
  - Is a dry, microfibrillar, purified, bovine collagen preparation
  - Is available in a powdery, dry, snow-like form or a compacted nonwoven web sheet form; also packaged in a delivery device for endoscopic procedures
  - When applied to a bleeding surface, it promotes clotting by attracting platelets to the substance which then release clotting factors.
  - Is used to control capillary bleeding
  - Avitene® should be used for topical use only and **NEVER** injected
  - General considerations:
    - Before applying **dry** product, the surgeon must blot bleeding surface with a dry sponge.
    - Avitene® should be applied with a dry smooth instrument because it will adhere to the wet surface of the instrument or glove.
    - Adhesions may result if Avitene® comes in contact with nonbleeding surface. Excessive material should be removed by irrigation of the wound after a few minutes.
    - Discard any unused portion.

✔ **NOTE:** Instat MCH® is another form of microfibrillar collagen hemostat. It is similar to Avitene® in action in that it is absorbable but removal is recommended.

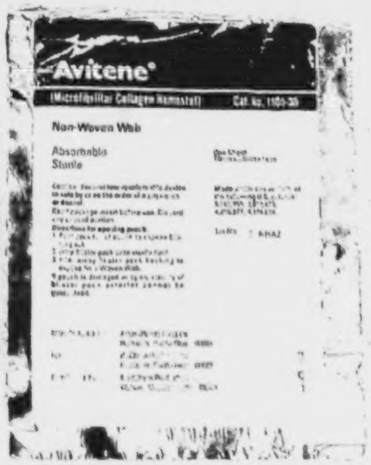

**Figure 16**
**Avitene**

### 10. Oxidized cellulose hemostatic agents

- Surgicel®, Surgicel NuKnit®, and Oxycel®
  - Are absorbable hemostatic collagen sponges
  - Are used as sterile packing material or may be cut to desired size to control bleeding at the surgical site
  - Acts by absorbing blood and forming an adhesive mass which stops bleeding
  - Surgicel® and Surgicel NuKnit® are available in a variety of sizes in a gauze form.
  - Oxycel® is available in two forms—cotton and gauze.
  - Excessive material should be removed from bleeding sites.

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Figure 17
Oxycel

11. **Absorbable collagen hemostatic sponges**

- Helistat®
  - Is a soft, pliable, absorbable collagen hemostatic sponge
  - Is available in various sizes
  - Is applied dry to bleeding surfaces
  - Must be kept dry, and should be applied with dry gloves and instruments.
  - Excess should be removed prior to wound closure.
  - Examples of other absorbable collagen sponges include Collastat®, Hemopad®, Instat®, and Superstat® which contain calcium chloride.

12. **Chemical hemostatic agents**

- Tannic acid
  - Is a powder made from an **astringent** plant
  - Is applied topically to the mucous membranes of the nose and throat to help capillary bleeding
  - Chemically cauterizes bleeding surface
- Silver nitrate
  - Is molded on an applicator stick
  - Is used topically as an astringent and an **antimicrobial** agent and used commonly in the treatment of burns

— Is used to cauterize wounds and removal of granulation tissue and warts

— Should not be used around the eyes because of its corrosive effect

KEY TERMS

**Granulation**—Soft, pink, fleshy projection that form during the healing process of a wound

**Microfibrillar**—The finest of fibrous cellular filament found in the cytoplasm of most cells

**Astringent**—An agent that has a constricting or binding effect

**Antimicrobial**—An agent that destroys or prevents the development of microorganisms

OBJECTIVE 12

**Select true statements concerning the characteristics of antibiotic/anti-infectives commonly used in surgery.**

1. **Are used to destroy or inhibit the growth of pathogenic microorganisms**
2. **May be used topically as an irrigating solution, applied as an ointment, or given intravenously before or during a surgical procedure for *prophylaxis* against postoperative wound infections**
3. **Most antibiotics are categorized in large classes such as aminoglycosides, cephalosporins, macrolides, penicillins, and tetracyclines.**
4. **Aminoglycosides**
    - Are bactericidal and are active against **aerobic**, **gram-negative** bacteria and some **gram-positive** bacteria such as Staphylococcus
    - Are completely absorbed when applied topically during a surgical procedure; intramuscular and intravenous are the most common routes of administration
    - Are used for short-term treatment of serious infections of the skin, bones, respiratory tract, alimentary tract, and central nervous system
    - Common aminoglycosides used in surgery include Amikin®, kanamycin (Kantrex®), gentamycin (Garamycin® and Jenamicin®), neomycin (Neobiotic®), streptomycin, tobramycin (Nebcin®).

KEY TERMS

**Prophylaxis**—A preventive measure to guard against a disease

**Aerobic**—Living in only the presence of oxygen

**Gram-negative**—A method of characterizing microorganisms where the stain has a pink color

**Gram-positive**—A method of characterizing microorganisms where the stain remains violet

5. **Cephalosporins**

- Are bactericidal and are active against many gram-positive and some gram-negative microorganisms
- Are used prophylactically in various surgical procedures to prevent postoperative wound infection
- Routes of administration include oral, intramuscular, and intravenous depending on the medication
- Are used for serious infections of the respiratory and genitourinary tract, skin, soft tissue, bone and joints
- Common cephalosporins used in surgery include Kefzol®, Ancef®, Duricef®, Zinacef®, and Rocephin®.

6. **Macrolides**

- Are bacteriostatic agents used against several gram-positive bacteria such as Streptococcus erythreus
- Are administered orally
- Common macrolides include erythromycin, which is available in a topical ointment and solution used for ophthalmic infections

7. **Penicillins**

- Are effective against a wide variety of gram-positive and gram-negative bacteria
- Can be administered orally, intramuscularly, or intravenously depending on the medication
- Are given prophylactically to patients preoperatively and intraoperatively to prevent postoperative wound infections
- Common penicillins include ampicillin, amoxicillin, carbenicillin, mezlocillin, penicillin V, and piperacillin.

8. **Tetracyclines**

- Are broad-spectrum antibiotics; have a bactriostatic action against many gram-positive and gram-negative bacteria
- Can be administered orally, topically, occasionally intramuscularly or intravenously

  Example: Chlortetracycline hydrochloride is available in an ophthalmic and topical ointment.

9. **Miscellaneous antibiotics**

✔ **NOTE:** Many topical anti-infective agents are available as ointments and sprays. There are many other specific antibiotic/anti-infective agents that you will encounter in surgery in addition to the ones covered in this module.

- Polymixin B sulfate (Aerosporin®)
  - Is used topically and in combination with other anti-infective agents or steroids for infections of the eyes, ears, mucous membranes, and the skin
- Bacitracin
  - Is used topically for infections caused by various bacteria
  - Is available in powder or ointment form
  - Keep powder in the refrigerator.
  - Dissolve powder in a saline solution.
  - Use powder topically for irrigation; powder should **NEVER** be injected.
  - Ointment is designed to be placed directly in the wound; ointment does not need to be refrigerated.

**OBJECTIVE 13** **Complete statements concerning narcotic analgesics.**

1. **Are primarily used to relieve pain preoperatively, intraoperatively, and postoperatively**
2. **Are capable of causing dependence with regular use**
3. **Are classified as controlled substances by the federal government**
4. **Special caution is required when handling controlled substances in the operating room. According to federal laws, narcotic medications must be kept in a locked cabinet and must be signed out when used. The Drug Enforcement Agency (DEA) has set standards for handling controlled substances. Institutional policies and procedures must be documented and strictly followed. Careful records must be kept of the kind, amount of drug, date of administration, patient, and the person giving the drug.**
5. **Adverse effects to narcotics include nausea, vomiting, respiratory depression, and reduced intestinal motility.**
6. **Narcotic *antagonists* such as naloxone (Narcan®) should be on hand to reverse the depressant effects of narcotics if needed.**
7. **Common narcotics used in surgery include:**
   - Morphine sulfate—Very potent, addictive narcotic that raises the pain threshold, produces sedation, and depresses respirations

- Meperidine hydrochloride (Demerol®)—Most common synthetic narcotic used for preoperative injections and postoperative pain; used as a substitute for morphine sulfate because it does not depress respirations as morphine does
- Fentanyl citrate (Sublimaze®)—Used as an adjunct to general anesthesia to relieve pain and produce sedation; 100 times more potent than morphine; commonly used in short surgical procedures and as a preoperative and postoperative medication because of its short duration
- Alfentanil (Alfenta®)—Ultra-short acting narcotic agent; has a slow onset lasting only about 10–15 minutes
- Sufentanil (Sufenta®)—Used to maintain a balanced general anesthesia; 5–10 times more potent than fentanyl but is rapidly absorbed by the body to provide a rapid recovery; its effects last between 20–45 minutes
- Cocaine hydrochloride—Used in surgery to shrink mucous membranes and to reduce bleeding in the nose; administered topically and **NEVER** injected due to its high toxicity

✔ **NOTE:** You will study more about narcotic agents used in anesthesia in Module 5-D "Anesthesia."

KEY TERM

**Antagonist**—A substance that counteracts the action of something else

**OBJECTIVE 14** **Match drugs used for ophthalmic surgery with their correct uses.**

1. **Anesthetic agents**—Used locally or topically to produce the absence of all sensation

   Examples: Xylocaine®, Marcaine®, Sensorcaine®, Ophthaine®, and Pontocaine®

2. **Antibiotics**—Used to prevent or treat infections; may be administered topically, or by an injection, but usually are administered by topical drops or ointment

3. **Irrigants**—Used to irrigate the anterior chamber to keep the cornea and eye tissue moist and to soak and rinse intraocular lenses

   Examples: Balanced salt solution (BSS), A-K Rinse®, Blinx®, and Irigate®

4. **Miotics**—Constrict the pupil to reduce intraocular pressure; also are used to help prevent the loss of vitreous humor in cataract surgery; are administered in a drop form

   Examples: Carbachol (IsoptoCarbachol®), Miostat®, and pilocarpine hydrochloride (Pilocar®, Isoptocarpine®), Miochol® is unstable in solution and should not be used after sitting for 15 minutes. Therefore, it should be prepared immediately before use.

5. **Mydriatics/Cycloplegics—Paralytic** agents used to dilate the pupil prior to ophthalmoscopy; administered by drop form

   Examples: Common mydriatics include atropine and phenylephrine (Neo-Synephrine®); common cycloplegics include Cyclogyl® and Mydriacyl®

6. **Enzymes**—Proteins that act as a catalyst to speed up chemical reactions

   Examples: Hyaluronidase (Wydase®) and alpha-chymotrypsin (Alpha-Chymar®, Zolyse®)

KEY TERM

**Paralytic**—The loss of sensation or movement

OBJECTIVE 15 **Select true statements concerning characteristics of diuretics.**

1. **Are used to prevent reabsorption of sodium and water by the kidneys**
2. **Draw fluids from the tissues and into the urinary system**
3. **In surgery, diuretics are commonly used to reduce intraocular or intracranial pressure.**
4. **Adverse effects of use include *hypokalemia*.**
5. **Diuretics commonly used in surgery include:**
   - Mannitol (Osmitrol®) is the most common osmotic diuretic used to provide a rapid reduction in intraocular pressure in patients with glaucoma and used in neurosurgery to reduce cerebral edema.
   - Furosemide (Lasix®) decreases intracranial pressure by quickly removing fluids that have accumulated because of a head trauma or an intracranial surgical procedure.

KEY TERM

**Hypokalemia**—An abnormally low concentration of potassium in the blood

OBJECTIVE 16 **Select true statements concerning the characteristics of steroids.**

1. **Are commonly used in surgery to reduce tissue inflammation and postoperative swelling**
2. **Are particularly useful in ophthalmic and orthopedic surgical procedures**
3. **Can be administered orally, topically, intramuscularly, and intravenously**

4. **Common *synthetic* steroids include hydrocortisone (Hydrocortone®, Cortef®, Solu-cortef®), prednisone, methylprednisolone (Medrol®, Depo-medrol®, Solu-medrol®), triamcinolone acetonide (Aristocort®, Kenacort®, Kenalog 40®), dexamethasone (Decadron®), and betamethasone (Celestone®).**

KEY TERM

**Synthetic**—Artificially prepared or made

OBJECTIVE 17 **Select true statements concerning the characteristics of hormones.**

1. **Hormones produced by the pituitary gland (oxytocics)**
    - Are used to stimulate the uterus to contract during labor
    - Are used in surgery to expel uterine contents (blood clots, placenta remnants) after a cesarean section or a therapeutic abortion
    - Commonly used oxytocics include synthetic oxytocin (Oxytocin®, Pitocin®, and Syntocinon®), and methylergonovine maleate (Methergine®).
2. **Hormones produced by the ovaries**
    - Estrogen and progesterone are used in replacement therapy after surgical removal of ovaries.
    - Estrogen is available in a cream form which can be applied to vaginal packing placed after a vaginal hysterectomy.
3. **Hormones produced by the pancreas**
    - Regulate the metabolism of glucose, a simple sugar used as an energy source
    - Glucagon stimulates the liver to break down glycogen in glucose which then increases blood sugar levels.
    - Insulin stimulates the liver to form glycogen from glucose which then lowers blood sugar levels.
    - Insulin may be administered during a surgical procedure to decrease an elevated blood sugar level in a diabetic patient.

OBJECTIVE 18 **Complete statements concerning characteristics of contrast media.**

1. **Are *radiopaque* dyes used to outline various anatomical structures through x-ray**
2. **Are commonly used in biliary surgery to determine the presence of stones which appear as dark spots against the white contrast media**

3. **Are commonly used in cardiovascular and gastrointestinal surgery to identify strictures**

4. **Syringes and containers containing contrast media on the sterile field must be labeled to prevent medication error.**

5. **Patients must be checked for allergies to iodine prior to administration of contrast media.**

6. **Common contrast media include:**

   - Diatrizoate sodium (Hypaque®, Renografin®, Conray®) are used for radiography of the biliary tract, kidney, and other internal strictures.
   - Diatrizoate meglumine (Cystografin®) is used for radiography of the urinary tract.
   - Iohexol (Omnipaque®) is used for radiography of the female reproductive organs and for viewing body structures such as the brain, spinal cord, liver, pancreas, kidneys, aorta, and blood vessels.

KEY TERM

**Radiopaque**—Impenetrable (solid) to x-rays or other forms of radiation

OBJECTIVE 19

**Match common dyes used in surgery with their correct descriptions.**

1. **Are used in surgery to mark skin incision lines and in diagnostic procedures to determine if internal structures are patent (open)**

2. **Are applied to the skin by using a cotton-tipped applicator or by using a manufactured skin marking pen**

3. **Common dyes include:**

   - Methylene blue—Used in surgery as a stain for marking the skin and to determine fallopian tube patency
   - Indigo carmine—Can be administered intravenously to color urine for evidence of bladder and kidney functions; may also be used for tracking fissures, fistulas, and determining the patency of fallopian tubes
   - Gentian violet—Purple dye used frequently in surgery to mark skin incision; should **NEVER** be injected
   - Lugol's solution (strong iodine)—Used to stain cervical tissue

     ✔ **NOTE:** Schiller's test uses iodine to test for cervical cancer.

   - Acetic acid (vinegar)—A colored staining agent used to identify areas of cervical dysplasia

**OBJECTIVE 20**

**Complete statements concerning characteristics of intravenous solutions.**

1. **Most patients scheduled for surgery will receive an intravenous solution when they come to the operating room.**
2. **Intravenous fluids are given intraoperatively to restore blood volume and replace fluids lost during the surgical procedure.**
3. **The intravenous route allows the surgical team, particularly the anesthesiologist, a convenient and efficient method for administering drugs and anesthesia agents as well as blood replacements and substitutes if needed.**
4. **Common intravenous solutions include:**

   - Normal saline (also called sodium chloride solution, NaCl) is the most common intravenous solution.

     ✔ **NOTE:** Normal saline solution designed for intravenous infusion should not be confused with normal saline designed for irrigation. Although these contain the same mixture, they are packaged differently. When heparin is added to an intravenous saline solution, it may be used to irrigate vessels in vascular procedures.

   - Dextrose in a water or saline solution (also called D5W or D5NS) is used for patients requiring an easily metabolized source of calories.

     ✔ **NOTE:** Dextrose in water is available in solution of 2.5%, 5%, 10%, and 50%.

   - Lactated Ringer's solution is a physiologic salt solution that may be used to replenish the patient's supply of electrolytes (potassium, calcium, and sodium), to improve circulation, or to stimulate renal activity.
   - Plasmalyte® and Isolyte E® are electrolyte balanced solutions which are compatible with the pH of blood. They are used to treat massive fluid and electrolyte loss.

**OBJECTIVE 21**

**Select statements concerning blood replacements, blood components, and blood substitutes.**

1. **Blood replacements and substitutes are commonly given intravenously for patients having a significant blood loss.**
2. **Blood components include whole blood, plasma, packed blood cells, and platelets.**
3. **Source blood replacements can be donor blood, *autologous* donation, autotransfusion, or blood substitutions.**
4. **Patients who are scheduled for an elective surgical procedure may elect to donate their own blood for surgery. The patient's blood is collected, processed, and stored for surgery by the blood bank unit. The autologous donation protects the patient from potential bloodborne disease transmission.**

5. **Another form of autologous donation used intraoperatively in surgery is called *autotransfusion*. This process involves using a "cell saver" to collect, process, and return the patient's own blood. Autotransfusion donations are routinely used during cardiovascular, peripheral vascular, and trauma procedures when immediate blood replacement is necessary due to excessive blood loss.**

6. **Blood substitutions include:**

   - Dextran® is an artificial plasma-volume expander which is especially valuable in treating **hypovolemic** shock resulting from hemorrhage.
   - Normal serum albumin and plasma protein fraction are both used to treat shock from hemorrhage and to combat **hypoproteinemia**. They act to supply **colloid** to blood and expand plasma volume.
   - Hetastarch (Hespan®) is also a common volume expander made of cornstarch.

KEY TERMS

**Autologous**—Originating within an individual

**Autotransfusion**—A method of collecting and returning the patient's own blood lost during a surgical procedure

**Hypovolemic**—A decrease in the blood volume that may be caused by internal or external bleeding, fluid loss, or inadequate fluid intake

**Hypoproteinemia**—A decrease in the amount of protein in the blood

**Colloid**—A glue-like substance, such as protein or starch

OBJECTIVE 22

**Match miscellaneous drugs used in surgery for emergency situations with their correct descriptions.**

1. **Aminophylline or theophylline ethylenediamine (Aminophyllin®)**—A spasmolytic that is used to treat acute and chronic bronchial asthma, bronchospasms, pulmonary emphysema, Cheyne-Stokes respirations, and pulmonary edema
2. **Atropine sulfate (Atropine®)**—An anticholinergic drug used to treat bradycardia and bradyarrhythmia; also administered preoperatively to dry up oral secretions
3. **Calcium chloride**—An electrolyte replacement given to increase the force of the myocardial contractions
4. **Dantrolene®**—A muscle relaxant given for the treatment of malignant hyperthermia

   ✔ **NOTE:** You will study more about malignant hyperthermia in Module 5-D: "Anesthesia."

5. **Digoxin (Lanoxin®)**—A drug that acts directly on the myocardium; used to treat congestive heart failure, atrial tachycardia, and atrial fibrillation and flutter; slows the heart rate and strengthens contractions

6. **Diphenhydramine hydrochloride (Benadryl®)**—A sedating antihistamine used with epinephrine to treat anaphylaxis

7. **Epinephrine (Adrenalin®)**—An adrenergic used as a vasoconstrictor, as a cardiac stimulant, and to relax bronchioles; used to treat anaphylactic reactions, asthmatic attacks, and local hemorrhaging; also used to prolong the action of local anesthetic agents

8. **Lidocaine hydrochloride (Xylocaine®)**—An antiarrhythmic used to treat premature ventricular contractions (PVCs), ventricular arrhythmias, or ventricular tachycardia; also used as a local anesthetic agent

9. **Norepinephrine injection (Levophed®)**—An adrenergic used to restore blood pressure in acute hypotensive states

10. **Papaverine®**—A vasodilator drug used to dilate small vessels for surgical procedures such as AV shunts, fistulas, or femeral-popliteal bypasses

11. **Potassium**—An electrolyte which can cause a cardiac irritability if a deficiency is present

12. **Sodium bicarbonate**—An alkalinizer used to treat metabolic acidosis, especially during a cardiac arrest

13. **Varapamil**—A calcium blocker used to treat arrhythmias and angina

KEY TERM

**Spasmolytic**—Stops or prevents spasms

OBJECTIVE 23

**Select true statements concerning the care and handling of medications.**

1. **It is the surgical technologist's responsibility to be aware of local, state, and federal regulations concerning drugs and their administration.**

2. **The role of the surgical technologist in the handling of drugs should be addressed in each institution's policy and procedure manual. Policies and procedures may vary from facility to facility so it is the surgical technologist's responsibility to become familiar with medication administration policies of their facility.**

   ✔ **NOTE:** A state law called the Practice Acts governs the ordering, dispensing, and administration of drugs. This law may vary from state to state. The Practice Acts state that only physicians, nurse practitioners, and physicians' assistants can prescribe medications.

3. **Only a registered nurse or physician can legally distribute medications to a surgical technologist. A verbal order from the physician for the distribution of a medication can only be taken by the nurse.**

4. **The surgical technologist is responsible for receiving, preparing, mixing, and labeling all drugs on the sterile back table after properly cross-referencing with the circulator.**

5. The surgical technologist NEVER administers medications to patient. However, they will be involved in the preparation and handling of medication during a surgical procedure.

6. Medication should NEVER be accepted from vials that are cracked or chipped.

7. Medication should NEVER be accepted if it appears discolored or suspicious.

8. NEVER use a drug if you are in doubt about the identification of the drug.

9. Do not accept a medication from a vial or bottle you have not identified. If the medications are not clearly identified, they must be discarded and new medications obtained.

10. Immediately label all medications, both container and syringes, on the sterile back table, by using a sterile marking pen or by another acceptable method.

11. Inadequate or improper labeling on the sterile field may be considered negligent.

12. NEVER use outdated medications. The composition and effect of the drug may be altered.

13. It is the responsibility of both the circulating nurse and the surgical technologist to make certain that the correct drug, correct amount, and the correct strength are administered.

14. Keep track of the amount of medication being used on the sterile field.

15. Keep track of how much irrigation solution is used within the wound so that blood loss can be determined.

OBJECTIVE 24

Complete statements concerning the procedure for the surgical technologist to accept medication from the circulator.

1. The principle of aseptic technique must be strictly followed when delivering and receiving medication onto the sterile field.

2. Identifying medication to be used on the sterile field is both the circulator and surgical technologist's responsibility. This dual responsibility reduces the potential for medication errors.

3. Important information about the drug must be identified on the medication label such as name, strength, amount, and expiration date.

4. The circulator obtains the medication and checks the integrity of container for cracks or discolored contents. The nurse shows the bottle to the surgical technologist.

5. The circulator reads the label aloud prior to delivering the medication to the sterile field.

6. The surgical technologist recites aloud the drug's name, amount, strength, and the expiration date.

7. The circulator distributes the drug to the surgical technologist into a sterile medicine cup or basin while maintaining aseptic technique.

8. The circulator shows the medication vial to the surgical technologist again.

9. The surgical technologist immediately labels the medication with the name and strength of the drug. The circulator leaves the empty medication bottle in the room until the completion of the procedure to confirm the medication if necessary.

10. Once the medication is on the sterile field, it is the surgical technologist's responsibility to pass the correct medication in the strength specified by the surgeon.

11. The surgical technologist is responsible for informing the surgeon of all medication and mixtures as the drug is passed intraoperatively. The surgical technologist should state the kind and percentage of the medication as he or she is passing the medication to the surgeon.

12. It is the surgical technologist's responsibility to remember the amount of medication used on the sterile field.

**OBJECTIVE 25**

## Assignment Sheet 1—Classify Various Drugs According to Type

Name ______________________ Date ____________

**Evaluation criterion** **Rating**

- Drugs are properly categorized ______

**Overall rating** ______

Evaluator's comments ______________________

**EXERCISE**

**DIRECTIONS** On the following page, classify the drugs by matching them with the categories. Categories may be used more than once.

**Categories**

1. Adrenergic
2. Antibiotic/anti-infective
3. Anticoagulant
4. Antihistamine
5. Blood substitute
6. Contrast media
7. Diuretic
8. Dye
9. Hemostatic agent
10. Intravenous solution
11. Narcotic analgesic
12. Narcotic antagonist
13. Oxytocic
14. Steroid
15. Vasodilator

**Drugs**

______ a. Gelfoam®

______ b. Morphine sulfate

______ c. Methergine®

______ d. Lasix®

______ e. Lactated Ringer's solution

______ f. Epinephrine

______ g. Thrombin

______ h. Kantrex

______ i. Tobramycin

______ j. Narcan®

______ k. Demerol®

______ l. Pitocin®

______ m. Mannitol

______ n. Methylene blue

______ o. Hypaque®

______ p. Bacitracin

______ q. Normal saline solution

______ r. Solu-Cortef®

______ s. Sublimaze®

______ t. Kefzol®

______ u. Heparin

______ v. Gentian violet

______ w. Renografin®

______ x. Avitene®

______ y. Penicillin

______ z Cocaine

______ aa. Oxycel®

______ bb. Papaverine®

______ cc. Vitamin K

______ dd. Indigo carmine

______ ee. Aerosporin®

______ ff. Surgicel®

______ gg. Decadron®

______ hh. Lugol's Solution

______ ii. Dextran®

______ jj. Benadryl®

______ kk. Tetracycline

______ ll. Isolyte E

**OBJECTIVE 26**

## Assignment Sheet 2—Use a Drug Information Reference

Name ______________________ Date __________

**Evaluation criteria** **Rating**

- Directions were followed _______
- Answers were correct _______
- Work was neat and legible _______

**Overall rating** _______

Evaluator's comments ______________________

______________________

______________________

**EXERCISE**

**DIRECTIONS** Using a drug information reference, such as the *Physician's Desk Reference* provided by your instructor, look up the required information for various drugs. Take a few minutes to become familiar with the way your drug reference book is divided so that you can turn to the correct page quickly and find the needed information.

**A. Hemostatic Agents**

Name of drug ______________________

Usual dosage ______________________

What it is used for ______________________

Side effects ______________________

______________________

______________________

______________________

### B. Antibiotics

Name of drug ______________________________

Usual dosage ______________________________

What it is used for ______________________________

Side effects ______________________________

________________________________________

________________________________________

________________________________________

### C. Anti-inflammatory Agents

Name of drug ______________________________

Usual dosage ______________________________

What it is used for ______________________________

Side effects ______________________________

________________________________________

________________________________________

________________________________________

### D. Antihistamines

Name of drug ______________________________

Usual dosage ______________________________

What it is used for ______________________________

Side effects ______________________________

________________________________________

________________________________________

________________________________________

## E. Analgesics

Name of drug ________________________________

Usual dosage ________________________________

What it is used for ____________________________

Side effects __________________________________

## F. Diuretics

Name of drug ________________________________

Usual dosage ________________________________

What it is used for ____________________________

Side effects __________________________________

## G. Antipyretics

Name of drug ________________________________

Usual dosage ________________________________

What it is used for ____________________________

Side effects __________________________________

## H. Antidepressants

Name of drug ____________________

Usual dosage ____________________

What it is used for ____________________

Side effects ____________________

____________________

____________________

____________________

**OBJECTIVE 27**

## Job Sheet 1—Receive Medication Onto the Sterile Field

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Assembled necessary supplies and equipment | _____ |
| • Followed directions | _____ |
| • Performed each step in appropriate sequence | _____ |
| • Followed aseptic technique | _____ |
| **Overall rating** | _____ |

Evaluator's comments ______________________________________

__________________________________________________________

__________________________________________________________

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Medication
- Medicine cup or small basin
- Small table
- Appropriate label
- Circulator
- Scrub person, gowned and gloved

**PROCEDURE**

✔ **NOTE:** Have your back table and Mayo stand prepared to simulate an actual operating room setting.

☐ 1. Place a medicine cup or small basin at the corner edge of the table, or hold in hand.

☐ 2. As circulator shows you the medication vial, verify **aloud** the name, dosage, amount of medication, and expiration date.

✔ **NOTE:** Depending on the medication, the circulator may need to draw up the medication into a syringe.

☐ 3. Watch as circulator distributes the medication to you by pouring directly from the medication vial or by injecting medication from a syringe into the medicine cup or basin.

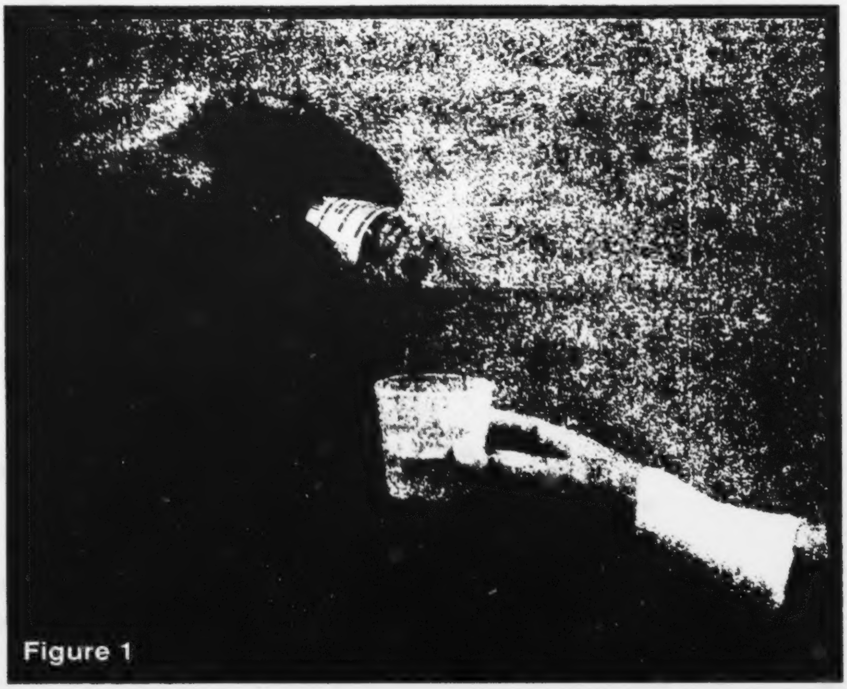

Figure 1

☐ 4. As circulator again shows you the medication vial, verify aloud the name, dosage, and amount of medication that you have received.

☐ 5. Label medication with name and dosage if more than one is being used.

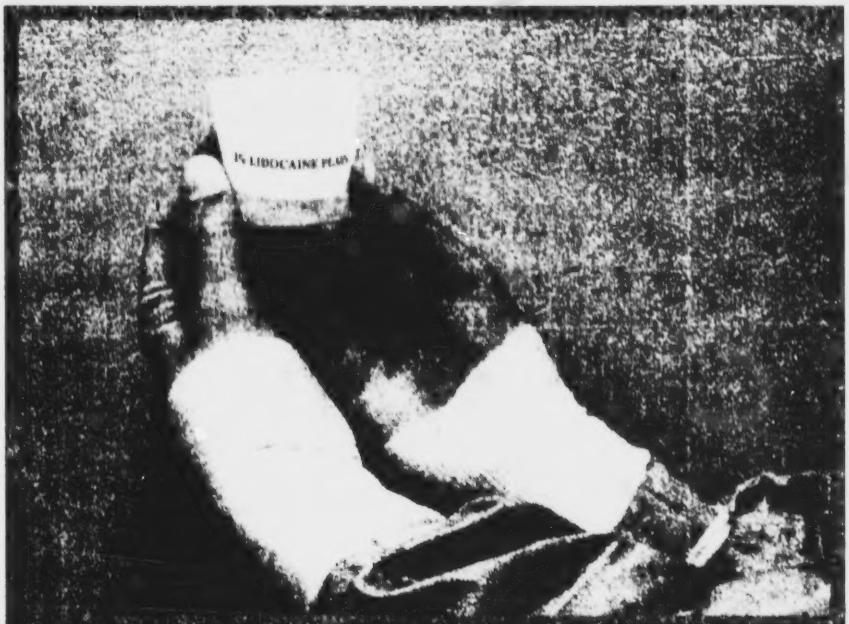

Figure 2

☐ 6. Leave empty vial in room until completion of operative procedure.

Evaluator's Comments: ______________________________

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# Introduction to Surgical Technology

## SECTION D:
## Pharmacology

## Module 5-D: Anesthesia

## Module Contents

**COMPONENTS**

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Module Objective Sheet ........ 5
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# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 5-D: Anesthesia

**PREREQUISITES:**
**Module 2-D**
**Module 3-D,**
**and Module 4-D**

### Learning Activities Sheet

Student name ______________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 15.

☐ 5. **Research** Online resources to learn more about preoperative medications and anesthesia used in the OR. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 6. **Study** Information Sheet, Objective 16 through Objective 30.

☐ 7. **Take** Written Test provided by your instructor.

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, repeat steps 4 and 6.

☐ 9. **Check** With your instructor for any additional assignments to be completed.

☐ 10. **Do** Additional assignments your instructor lists below.

______________________________

______________________________

______________________________

☐ 11. **Take** Module Review provided by your instructor.

☐ 12. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 13. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 5-D: Anesthesia

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to complete statements concerning preoperative medications, types of anesthetics, and various agents used to obtain anesthesia. You should demonstrate these competencies by scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Complete statements concerning the ideal anesthetic agent used in anesthesiology.
2. Complete statements concerning the preanesthetic preparation of the patient.
3. Select purposes of preoperative medications.
4. Complete statements concerning the selection of preoperative medications.
5. Complete statements concerning classifications of premedications.
6. Select true statements concerning anesthesia.
7. Identify sites involved in the pathway of pain.
8. Distinguish among types of anesthetics.
9. Distinguish between methods of administering a general anesthetic.
10. List agents used for general anesthesia.
11. List the four phases of general anesthesia.
12. Match stages of general anesthesia with their correct descriptions.
13. Match types of local or regional anesthetics with their correct descriptions.
14. List agents used for local or regional anesthesia.
15. Match other anesthetic techniques occasionally used with their correct descriptions.
16. Complete statements concerning the characteristics of muscle relaxant drugs.
17. Distinguish between types of muscle relaxants.
18. List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia.
19. List narcotic antagonists used intraoperatively.
20. Discuss the care of the anesthetized patient.

21. Discuss circulator and scrub personnel roles during administration of anesthesia.
22. List possible complications of anesthesia.
23. Select true statements concerning malignant hyperpyrexia—malignant hyperthermia syndrome.
24. Complete statements concerning hemolytic reactions.
25. Complete statements concerning anaphylactic reactions.
26. Distinguish among actions of the surgical team if cardiac arrest occurs on the operating room table.
27. Match OR anesthesia equipment used for delivering anesthetics and/or monitoring the patient with their correct descriptions.
28. Match equipment used as adjuncts to anesthesia with their uses.
29. List types of thermoregulatory devices used in the operating room.
30. Complete statements concerning hemostasis and blood replacement.

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# Introduction to Surgical Technology
## Section D: Pharmacology
## Module 5-D: Anesthesia

## Information Sheet

OBJECTIVE 1

**Complete statements concerning the ideal *anesthetic* agent used in *anesthesiology*.**

1. **For the patient, the ideal anesthetic agent is rapid-acting, easily reversed, and provides *analgesia* extending into postoperative period.**
2. **For the surgeon, the ideal anesthetic agent produces good muscular relaxation and minimum side effects.**
3. **For the *anesthesiologist*, the ideal anesthetic agent has a wide margin of safety, leaves the body unaltered, is potent, allows a high percentage of oxygen to be used, and has a low level of toxicity.**

KEY TERMS

**Anesthetic**—Agent that produces anesthesia

**Anesthesiology**—The branch of medical science concerned with the administration of anesthetics and the condition of the patient while under anesthesia

**Analgesia**—Decrease of or insensibility to pain

**Anesthesiologist**—A medical physician who is a specialist in the field of anesthesiology

OBJECTIVE 2

**Complete statements concerning the preanesthetic preparation of the patient.**

1. **Preoperative *anesthesia* assessment should be made by the anesthesia representative before the scheduled surgery.**
2. **The anesthesia representative will perform the following tasks during the preoperative visit:**
   - .Explain to the patient basically what will be done in surgery concerning anesthesia.
   - Explain the effects of the anesthesia.
   - Inform the patient of possible side effects and complications from the anesthesia.
   - Allow the patient to ask questions concerning his/her anesthetic care to alleviate possible fears.
   - Perform a brief history and physical on the patient especially noting any allergies; history of liver, kidney, or heart disease, or endocrine disorders; and note the medications that the patient is currently taking.

- Evaluate the patient's laboratory data and diagnostic studies such as electrocardiogram and chest x-ray.
- May order preoperative medications.

3. **The surgical patient should ideally be NPO for 6-8 hours prior to the induction of anesthesia to prevent vomiting and aspiration of gastric contents. However, the NPO time period may vary from institution to institution.**
4. **Preoperative medications are usually given one hour before surgery, but may be given intravenously after the patient arrives in the surgical suite.**

KEY TERM

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**Anesthesia**—The absence of essentially all sensation

OBJECTIVE 3 **Select purposes of preoperative medications.**

1. **To relieve preoperative anxiety and apprehension**
2. **To produce some *amnesia***

KEY TERM

---

**Amnesia**—Loss of memory

3. **To decrease secretions in respiratory tract**
4. **To raise the pain threshold**
5. **To assist in easier and smoother induction of anesthesia**
6. **To inhibit nausea and vomiting**
7. **To raise the pH in the stomach and induce emptying of the stomach**

OBJECTIVE 4 **Complete statements concerning the selection of preoperative medications.**

1. **Selection is made by anesthesiologist.**
2. **Dependent on patient's:**
    - Physical condition
    - Emotional status
    - Age
    - Weight

3. **Also dependent on:**
   - Degree of relaxation necessary
   - Anesthesiologist's own personal preference

OBJECTIVE 5 **Complete statements concerning classifications of premedications.**

1. **Sedatives-hypnotics and tranquilizers**
   - Given to reduce anxiety, for sedation, and **antiemetic** effect; cause drowsiness, but do not counteract pain
   - Drugs which produce excellent amnesia, mild sedation, and reduced anxiety include:
     - Diazepam (Valium®).
     - Midazolam (Versed®).
   - Drugs which minimize nausea and vomiting include:
     - Promethazine (Phenergan®).
     - Hydroxyzine (Vistaril®).
     - Droperidol (Inapsine®).

KEY TERM

**Antiemetic**—Agent that prevents or relieves nausea and vomiting

2. **Narcotic analgesics**
   - Given to reduce the perception of pain, raise the pain threshold, and decrease the amount of anesthesia needed during the operation
   - Are divided into groups:
     - Opiates — Morphine sulfate — Not commonly used because it causes deep **narcosis**, respiratory depression, and sometimes nausea and vomiting.
     - Synthetic opiates
       - Meperidine hydrochloride (Demerol®) is more commonly used because it produces fewer undesirable side effects than morphine and gives good analgesia.
       - Fentanyl (Sublimaze®) is faster-acting and of shorter duration than morphine or Demerol®.

KEY TERM

**Narcosis**—Unconscious state due to narcotics

- Side effects of narcotics:
  - Are respiratory depressants
  - May cause nausea, vomiting, and urinary retention
  - Capable of causing dependence with regular use and are classified as controlled substances by the federal government

3. **Anticholinergic (antimuscarinic) drugs**

- Are given for their parasympathetic depressant action
- Inhibit mucous secretions in the mouth, respiratory tract, and digestive tract
- Increase heart and respiratory rates and are bronchodilators
- Have little effect on blood pressure
- Common anticholinergic drugs include:
  - Atropine sulfate.
  - Glycopyrrolate (Robinul®).
  - Scopolamine hydrobromide (Scopolamine®).

✔ **NOTE:** This is more frequently given as a supplement during the operation than as a premedication because it may produce excitement, rage, and hallucinations.

4. **Antacid/H2-receptor blocking agents**

- The anesthesiologist may order an antacid or an $H_2$ receptor blocking agent to alter the pH of the patient's stomach contents. A higher pH will cause less damage to the lungs in the advent of vomiting and aspiration.
- Common antacids include:
  - Tums®.
  - Pepcid®.
- Common H2-receptor blocking agents include:
  - Cimetidine (Tagamet®).
  - Ranitidine (Zantac®).

5. **Antiemetics**

- Promote emptying of the stomach to decrease chance of vomiting and aspiration
- Reglan® is an example of an antiemetic used preoperatively.

**OBJECTIVE 6**

**Select true statements concerning anesthesia.**

1. **Anesthesia involves the administration of potentially lethal drugs and gases.**
2. **Today's *general anesthetic agents* are not flammable.**

   ✔ **NOTE:** The older anesthetic agents such as ether, chloroform, and cyclopropane (orange tank) were flammable.

KEY TERM

**General anesthetic agents**—Produce a state of reversible unconsciousness in which motor, sensory, mental, and reflex functions are temporarily lost

3. **Anesthesiologist provides skilled induction, careful maintenance of anesthesia during procedure, and prevents postoperative complications.**
4. **Anesthesiologist evaluates the following when determining types of anesthetic to use:**
   - **Patient factors**
     - Age of the patient
     - The general health of the patient
     - Pre-existing conditions or diseases

       Examples: Heart disease, allergies
     - Current medications that the patient is taking
     - Any allergies that the patient may have
     - If the patient has a history of substance abuse
     - Laboratory and X-ray findings
     - Whether or not it is an emergency procedure

       ✔ **NOTE:** In emergency surgery, it is important to know the time since the patient's last meal.
   - **The type and duration of the procedure**
   - **The surgeon's preference**
   - **The patient's preference**
   - **The anesthesiologist's/*anesthetist*'s preference**

KEY TERMS

**Anesthetist**—Any person other than the physician who administers anesthesia; can include **Certified Registered Nurse Anesthetist (CRNA)** or Physician Assistant (PA) depending on location of hospital

**Certified Registered Nurse Anesthetist (CRNA)**—A registered nurse trained in the administration of anesthesia

5. **Maintenance of general anesthesia involves:**

- Lightest level of anesthesia is maintained.
- Body must not be deprived of oxygen.
- Patient remains asleep.
- Patient is free from pain.
- Muscle relaxation must be present.

  ✔ **NOTE:** Proper amounts of muscle relaxation drugs are administered to provide adequate muscle relaxation throughout the procedure.

- Autonomic reflexes are constantly monitored.

  ✔ **NOTE:** Anesthetic agents affect the cardiovascular and respiratory system.

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**Objective 7**

## Identify sites involved in the pathway of pain.

From nerve endings in a wound → to the nerves → through the paravertebral space → through the epidural space → through the subarachnoid space → to the spinal cord → to the cerebral (sensory) cortex of the brain.

✔ **NOTE:** The passage of the impulse can be interrupted at any site along the route. The site selected to stop the nerve impulse will determine the types of anesthetic given.

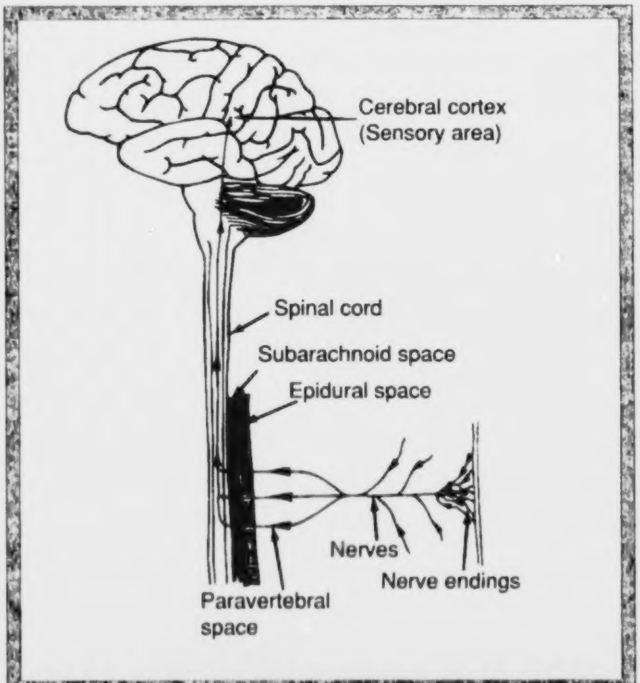
Cerebral cortex (Sensory area)
Spinal cord
Subarachnoid space
Epidural space
Nerves
Nerve endings
Paravertebral space

Figure 1
Pathway of pain

**Objective 8**

## Distinguish among types of anesthetics.

1. **General anesthesia**
   - Permeates the entire body and affects all of its functions.
   - Is transported by way of the bloodstream.
   - Results in loss of consciousness and blockage of the pain-transmitting center of the brain.
   - Results in an immobile, quiet patient who does not remember the operative procedure.
2. **Balanced (neuroleptic) anesthesia**—Properties of general anesthesia are produced by combining inhalation anesthetic agents with intravenous drugs.

3. **Spinal anesthesia**
   - Pain sensation is blocked at a level below where the drug is placed.
   - Anesthetic agent is injected in the spinal canal.
   - Patient remains conscious.
4. **Regional anesthesia**
   - Pain control is obtained by anesthetizing the sensory nerves in one area or region of the body.
   - Patient remains conscious.
5. ***Local* anesthesia**
   - Pain is controlled by infiltrating the surgical site with a local anesthetic.
   - Patient remains conscious.
   - Anesthesiologist is not involved in the care of the patient. A registered nurse monitors the patient's vital signs and administers sedative or analgesic drugs as ordered by the surgeon.

KEY TERM

**Local**—Limited to one place or part

6. **Monitored anesthesia care** (local standby or anesthesia standby)
   - Pain control is obtained by infiltrating the surgical site with a local anesthetic.
   - Anesthesiologist may supplement the local anesthesia with intravenous drugs that provide sedation and systemic analgesia.

     ✔ **NOTE:** The anesthesiologist monitors the patient's vital signs. This technique may be used for critically ill patients who may not tolerate general anesthesia or for patients undergoing minor procedures.

OBJECTIVE 9 **Distinguish between methods of administering a general anesthetic.**

1. **Inhalation**—Unconsciousness is induced by the patient breathing in anesthesia agents and oxygen which are absorbed into the bloodstream.
2. **Intravenous**
   - Unconsciousness is induced by intravenous administration of a drug directly into the bloodstream.
   - Produces rapid, pleasant general anesthesia
   - Does not cause muscle relaxation
   - Is used for short surgical procedures or as an induction agent to be immediately followed by inhalation anesthesia

OBJECTIVE 10

**List agents used for general anesthesia.**

1. **Inhalation anesthesia agents**

- Halothane (Fluothane®)
- Isoflurane (Forane®)
- Desflurane (Suprane®)
- Sevoflurane (Ultane®)
- Nitrous oxide ($N_2O$)

✔ **NOTE:** Ether, chloroform, and cyclopropane (in orange tank) are rarely used today because they are flammable and have undesirable side effects. Methoxyflurane and enflurane are also seldom used because of side effects.

2. **Intravenous anesthesia agents**

- Thiopental sodium (pentothal sodium)
- Thiamylal sodium (Surital®)
- Methohexital sodium (Brevital®)
- Propofol (Diprivan®)
- Etomidate (Amidate®)
- Ketamine hydrochloride (Ketalar®, Ketaject®)

✔ **NOTE:** Ketamine is rarely used because of undesirable side effects.

OBJECTIVE 11

**List the four phases of general anesthesia.**

1. **Induction**

- Begins with administration of anesthetic agents; continues until a maintenance level of anesthesia is achieved
- Patient may be intubated with an endotracheal tube to keep the airway patent during the surgical procedure.
- Possible complications include:
    - Hypotension due to cardiovascular depression.
    - Aspiration of stomach contents.
    - Bronchospasm.
    - Difficult or impossible airway control.

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- Allergic reaction to one of the drugs given.
- Other complications.

KEY TERM

**Endotracheal**—Within the trachea

2. **Maintenance**

- Begins before surgical procedure; continues and ends with completion of procedure.
- Accomplished with inhalation agents, local anesthetics, or intravenous agents.
- Possible complications include:
  - Hypotension due to cardiovascular depression.
  - Allergic reactions.
  - Failure to oxygenate the patient adequately.
  - Disconnection of the patient from the anesthesia machine.
  - Awakening during anesthesia.
  - Pressure injuries from positioning.
  - Other complications.

3. **Emergence**

- Begins when patient begins to emerge from anesthesia and ends when patient is ready to leave the operating room.
- **Extubation** of the patient may be performed.
- Possible complications include:
  - Early movement causing disruption of immobilized extremity.
  - Reacting to the endotracheal tube causing coughing and increased blood pressure and bleeding.
  - Combativeness.
  - Hypotension from rough repositioning of patient to transport bed.
  - Aspiration of stomach contents if the patient is extubated too early or if they gag on the endotracheal tube.

- Bronchospasm if the patient has a reactive airway and the airway becomes stimulated by blood, mucous secretions, the endotracheal tube, or something else at the time of awakening.
- Muscle rigidity including the jaw and occlusion of the endotracheal tube.
- Laryngeal spasm if the vocal cords are stimulated and spasm, which closes off the airway.
- Loosening or breaking of teeth during airway control.
- Other complications.

KEY TERM

**Extubation**—Removal of endotracheal tube

4. **Recovery**

- Begins when patient enters post-anesthesia recovery unit and ends when patient becomes responsive.
- Possible complications include:
  - Delayed or continued allergic reactions.
  - Loosening or breaking of teeth during airway control.
  - Nausea and/or vomiting.
  - Shivering due to loss of temperature while in the operating room.
  - Other complications.

OBJECTIVE 12 **Match stages of general anesthesia with their correct descriptions.**

1. **Stage I—Conscious analgesia stage**
   - The patient is awake and has a decreased sensitivity to pain or feels no pain.
2. **Stage II—Excitement stage**
   - The patient loses his or her inhibitions and may fight or struggle briefly.
3. **Stage III—Surgical anesthesia stage**
   - The patient is unconscious and depressed enough by the anesthetic that surgery may be performed without serious reaction by the body.
4. **Stage IV—Medullary paralysis stage**
   - The patient is depressed severely and life support functions may be impaired. This stage may lead to the death of the patient if actions aren't taken immediately.

**OBJECTIVE 13** **Match types of local or regional anesthetics with their correct descriptions.**

1. **Spinal block**

- Injected into the cerebrospinal fluid (CSF) in the subarachnoid space of the lumbar region to block the roots of the spinal nerves; causes massive nerve block and muscle relaxation below the point of injection
- Injected between 3rd and 4th, or 4th and 5th lumbar vertebrae
- Used for surgery on lower portion of the body

> **Caution:** Trendelenburg position can be used only after the drugs have fixed to the nerves. Always consult the anesthetist before changing position.

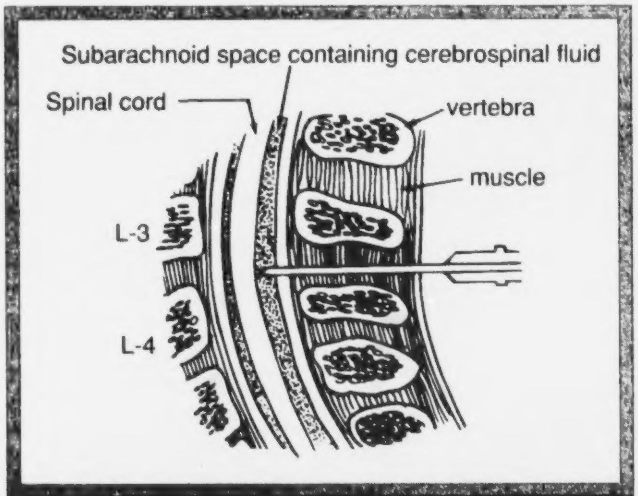
Subarachnoid space containing cerebrospinal fluid
Spinal cord
vertebra
muscle
L-3
L-4

**Figure 2**
Spinal block

2. **Epidural block**

   - Injected just outside the dura in the epidural space
   - Used for anesthesia of lower limbs or perineal area, and for relief of prolonged pain as with obstetrical patients

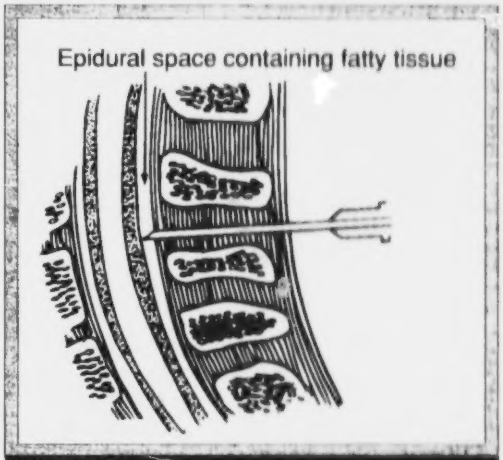

**Figure 3**
Epidural block

3. **Paravertebral block**—Injected near spinal nerves as they emerge through the epidural space

4. **Nerve block or field block**

   - Injected around a main nerve trunk at a site between operative site and entry of nerve into spinal cord, causing blockage of painful stimuli to the brain
   - Used for dental work, relief of intractable pain, and procedures on extremities

   Examples: Digital block for entire finger, brachial block for entire hand, wrist, and arm.

5. **Bier block**

   - Intravenous injection of local anesthetic to an extremity below level of a tourniquet
   - Used for extremity surgery that will last less than an hour
   - Blood is drained from extremity by compression and a tourniquet is inflated; anesthetic drug is injected intravenously
   - Extremity remains painless as long as tourniquet is inflated.
   - Analgesics may be given for tourniquet pain.

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6. **Local infiltration block**

   - Injected under the skin to anesthetize the nerve endings and nerve fibers
   - Used for minor surgery, excision of small lesions, and dental work

   ✔ **NOTE:** A vasoconstrictor is commonly used with a local anesthetic to prevent it from being carried away form the injection site.

7. **Topical anesthesia**—Directly applied to a mucous membrane to produce insensibility of the nerve endings

OBJECTIVE 14 **List agents used for local or regional anesthesia.**

1. **Cocaine hydrochloride (cocaine) (only for topical application)**
2. **Procaine hydrochloride (Novocain®)**
3. **Lidocaine hydrochloride (Xylocaine®, lignocaine)**

   ✔ **NOTE:** This is one of the most widely used local anesthetic agents.

4. **Tetracaine hydrochloride (Pontocaine®)**
5. **Mepivacaine hydrochloride (Carbocaine®)**
6. **Bupiviacine hydrochloride (Marcaine®, Sensorcaine®)**
7. **Hyaluronidase (Wydase®)—Added to local anesthetics to facilitate its action**

   ✔ **NOTE:** Epinephrine (Adrenalin®) may be added to local anesthetics for its vasoconstriction action. There are other local anesthetic agents for various uses in addition to the common ones listed here.

**Caution:** Overdosing with local anesthetic agents may cause severe cardiac and/or C.N.S complications.

OBJECTIVE 15 **Match other anesthetic techniques occasionally used with their correct descriptions.**

1. **Cryoanesthesia**

   - Involves blocking nerve conduction by means of surface cooling of a localized area
   - Used in topical procedures such as removal of warts and noninvasive surface lesions

2. **Hypothermia**

   - Involves cooling of a part or the entire body
   - Generalized hypothermia causes decrease in all metabolic processes with slowing of circulatory rate and decrease of oxygen requirements.

- Equipment involved is the hypothermia blanket, coolant, thermometer, and hypothermia machine.
- May be used in cardiac and neurosurgery and for burns and leg amputations

3. **Hypnoanesthesia**
   - Seldom used alternative to local or regional anesthesia that produces an altered state of consciousness through the use of hypnosis
4. **Acupuncture**
   - Alternative to conventional anesthesia that focuses on inserting needles into meridian points on the body to stimulate the brain to release endorphins which relieve or block pain

OBJECTIVE 16 **Complete statements concerning the characteristics of muscle relaxant drugs (neuromuscular blockers).**

1. **Used because some anesthetic gases used during a procedure render the patient unconscious but do not produce adequate muscle relaxation**
2. **Are given in conjunction with the anesthetic gas to allow the degree of muscle relaxation the surgeon needs**
3. **Administered intravenously in small dosages at various intervals during the surgical procedure**
4. **Interferes with passage of impulses from motor nerves to skeletal muscles**
5. **Use has eliminated the need for deep inhalation anesthesia to produce muscle relaxation**
6. **Chief danger is respiratory depression because all skeletal muscles are paralyzed, including the diaphragm and accessory muscles of respiration**

OBJECTIVE 17 **Distinguish between types of muscle relaxants.**

1. **Non-depolarizing agents**
   - Prevent muscle contractions
   - Bind to cholinergic receptors to prevent the union of acetylcholine to the receptor
   - Do not cause muscular fasciculations
   - Common agents include:
     - — Tubocurarine chloride (Curare).
     - — Pancuronium bromide (Pavulon®).
     - — Vecuronium bromide (Norcuron®).
     - — Atracurium besylate (Tracrium®).
     - — Mivacurium chloride (Mivacron®).

- Antagonist used is neostigmine (Prostigmin®).

KEY TERM

**Antagonist**—Drug that counteracts the action of something else

2. **Depolarizing agents**

- Act similarly to acetylcholine, but for a longer period of time
- Cause persistent depolarization that produces fasciculations followed by flaccidity

  Common agents include:

  — Succinylcholine chloride (Anectine®, Quelicin®, Gucostrin®).

  — Decamethonium bromide (Syncurine®).

- No antagonist is available; the drug must be allowed to wear off by itself.

OBJECTIVE 18 **List supplemental agents used in conjunction with oxygen to accomplish complete anesthesia.**

✔ **NOTE:** These may be administered intraoperatively on short procedures.

1. **Narcotic agents**

- Morphine sulfate
- Fentanyl (Sublimaze®)
- Sufentanil citrate (Sufenta®)
- Alfentanil (Alfenta®)
- Meperidine hydrochloride (Demerol®)

2. **Tranquilizing agents**

- Diazepam (Valium®)
- Midazolam (Versed®)
- Droperidol (Inapsine®)

OBJECTIVE 19 **List narcotic antagonists used intraoperatively.**

✔ **NOTE:** An antagonist drug cancels the action of another drug or reverses its effects. Narcotic (opiate) antagonists can reverse respiratory depression produced by narcotics.

1. **Naloxone hydrochloride (Narcan®)**

   ✔ **NOTE:** Although the following agonist/antagonists are narcotic antagonists they are used more for their analgesic qualities than their antagonistic qualities.

2. **Nalbuphine hydrochloride (Nubain®)**
3. **Butorphanol tartrate (Stadol®)**
4. **Pentazocine hydrochloride (Talwin®)**
5. **Burenorphine hydrochloride (Buhrenex®)**

**OBJECTIVE 20** **Discuss the care of the anesthetized patient.**

1. **Patients must be positioned properly to avoid pressure points, compression of nerves, or interference of respirations or circulation to an extremity. DO NOT LEAN ON THE PATIENT DURING SURGERY.**
2. **Change patient's position slowly and gently to allow for adjustment of circulatory system.**
3. **Patients must be transferred to the carrier carefully and gently to avoid straining muscles and ligaments; the anesthesiologist protects the patient's neck and head.**
4. **Since hearing is the last sensation to succumb to anesthesia, OR personnel must be aware that surgical patients are very vulnerable to auditory stimuli. Avoid room noise and conversations.**

**OBJECTIVE 21** **Discuss circulator and scrub personnel roles during administration of anesthesia.**

1. **Be aware of hospital policy regarding hospital personnel helping with the administration of anesthesia.**
2. **May be asked to assist with the Sellick maneuver which involves applying pressure on the cricoid cartilage to occlude the esophagus and prevent the aspiration of stomach contents.**
3. **When assisting anesthesia personnel with:**
   - General anesthesia—Be familiar with anesthesia equipment and procedures, such as starting and connecting IVs, intubation of the patient, positioning the patient, setting up thermoregulatory devices, etc. so that you will be able to help if needed.
   - Spinal anesthesia—May be asked to set up equipment or open trays for the administration of spinal anesthesia. It may also be necessary to help position the patient for the administration of the spinal.
   - Regional anesthesia—May be asked to set up equipment and assist the anesthetist in the administration of regional anesthesia.
4. **When dispensing local anesthesia, the circulator and scrub personnel may be asked to help the anesthetist draw up local anesthetic agents or they may have to draw the agents up for the anesthetist. When drawing up any medication, including local anesthetic agents, the surgical technologist should check the label on the medication with the circulating nurse, the anesthetist, or the surgeon to ensure administration of correct medication.**

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OBJECTIVE 22

**List possible complications of anesthesia.**

1. **Excitement**
2. **Respiratory obstruction**
3. **Bronchospasm**

   ✔ **NOTE:** At any time during administration of an anesthetic, the small airway muscles may constrict making it difficult for air to move in and out of the lungs.

4. **Laryngeal spasm**

   ✔ **NOTE:** During induction or emergence, the vocal cords may spasm by reflex and make it difficult or impossible for air to move in and out of the lungs.

5. **Aspiration of stomach contents or blood into the lungs during anesthesia causing aspiration pneumonia**
6. **Vomiting**

   ✔ **NOTE:** If the patient vomits during general anesthesia, they do not have the protective reflexes necessary to prevent aspiration of the stomach contents into the lungs. Therefore, in the event of vomiting, the patient's head should be turned to the side, and, if possible, the entire patient should be turned to their side. Suction should also be available, and you could tilt the patient's head into the down position (Trendelenburg). All of these things combined may help prevent aspiration.

7. **Damage to teeth or dental work**
8. **Eye injury due to drying of cornea or pressure from positioning**
9. **Reaction to drugs or blood transfusions**
10. **Injury to nerves due to improper positioning**
11. **Fluid and electrolyte imbalance**
12. **Hypothermia**
13. **Shock (neurogenic or secondary hemorrhage)**

    ✔ **NOTE:** Allergic reactions, loss of blood (hypovolemia), reaction to the anesthetic agent, or other variables may cause shock (lowered blood pressure).

14. **Cerebral complications:**
    - Cerebral vascular accident
    - Delirium
15. **Cardiac arrest or cardiac arrhythmias**

    ✔ **NOTE:** Many factors such as manipulation of the heart, drug administration, poor oxygenation, hypoventilation, or the anesthetic agent may cause cardiac arrhythmias or cardiac arrest.

16. **Malignant hyperthermia**

17. **Hypoxia**

✔ **NOTE:** Hypoxia is a condition in which less than adequate levels of oxygen are in the blood for one or many reasons. Dark blood in the operative field may signal hypoxia.

OBJECTIVE 23 **Select true statements concerning malignant hyperpyrexia—malignant hyperthermia syndrome.**

1. **Is a rare, life-threatening complication most frequently seen in children and adolescents which may be triggered by drugs commonly used in anesthesia.**

   ✔ **NOTE:** Succinylcholine and the volatile anesthetic agents, especially halothane, are the most frequently implicated triggering agents.

2. **In the past, mortality ranged from 50% to 80%, but proper treatment has significantly reduced the incidence of fatalities and complications.**
3. **It is generally transmitted as a dominant trait.**
4. **Characteristics include generalized contracture of skeletal muscles, marked temperature elevation, tachycardia, metabolic acidosis, cardiac dysrhythmia, and hypoxia.**
   - The body temperature may increase one degree every five minutes.
   - Temperatures greater than 109.4 degrees have been reported.
5. **May occur during induction or maintenance of anesthesia, but can also occur postoperatively.**
6. **All OR personnel should be familiar with the protocol of its management.**
7. **Treatment is the immediate infusion of the drug Dantrolene sodium, which is a skeletal muscle relaxant. The anesthetic that triggered the reaction must be discontinued or the technique changed. The patient needs to be ventilated with 100% oxygen and the anesthesia hoses, soda lime canister, and anything else that might have some residue of the offending anesthetic agent should be changed.**
8. **Patients known or suspected to have this syndrome can be anesthetized with minimal risk if appropriate precautions are taken. (Dantrolene is administered preoperatively.)**
9. **Relatives of persons with malignant hyperthermia should be evaluated and tested for presence of the disease.**

OBJECTIVE 24 **Complete statements concerning hemolytic reactions.**

1. **A hemolytic reaction occurs when the wrong type of blood is given to the patient (blood type mismatch).**
2. **When the wrong type of blood is given, the body reacts by destroying the invading cells. Severe hypotension may result and the clotting system may be activated resulting in D.I.C. (disseminated intravascular coagulopathy) which may block the kidneys and use up the clotting factor resulting in bleeding.**

3. Blood may be seen in the urine.
4. Very low blood pressure may be noted.
5. The transfusion will be stopped and various actions taken to overcome the reaction, such as fluid administration, and the administration of drugs to support the blood pressure, renal blood flow, and treat bleeding.
6. The surgical technologist needs to be aware there is a life threatening reaction occurring and stay sterile and be ready to help as necessary. This reaction can be prevented by ensuring that the patient receives the correct blood.

OBJECTIVE 25 Complete statements concerning anaphylactic reactions.

1. Anaphylaxis is a severe allergic reaction. The histamine that is released causes constriction of the airways (difficult ventilation), vascular dilation (hypotension), and leakage of fluid from the bloodstream into the intravascular spaces and lungs (lowered circulation blood volume and shock and pulmonary edema with resulting difficulty in oxygenation).
2. The anesthetist may have the patient exhale against pressure to improve oxygenation.
3. Fluid may be given to correct hypotension. Drugs may be given to increase blood pressure.
4. The surgical technologist should be aware that an anaphylactic reaction is life threatening. When a patient is experiencing an anaphylactic reaction, it is important that the surgical technologist stay sterile and be ready to help as necessary.
5. Anaphylaxis can be prevented by being aware of the patient's allergies.

OBJECTIVE 26 Distinguish among actions of surgical team if cardiac arrest occurs on the operating room table.

1. Anesthesiologist
   - Usually directs the resuscitation efforts
   - Delivers orders and makes decisions concerning medications and defibrillation
   - Maintains clear airway by suctioning, **intubation**, or use of a face mask to administer 100% oxygen under intermittent positive pressure

KEY TERM

**Intubation**—Insertion of endotracheal tube

2. Surgeon
   - Works together with anesthesiologist in resuscitation
   - Attempts closed chest compressions

- May inject heart with stimulants
- May perform open cardiac massage

✔ **NOTE:** The surgeon will need a knife to make the incision and a chest retractor to continue for any length of time.

- May do tracheostomy

3. **Circulating nurse**

- Records time of arrest
- Activates emergency assistance alarm
- Obtains needed equipment such as defibrillator cart ("Crash Cart") and medications
- Documents all medications given, including the time given and dosage
- Maintains accuracy of sponge and needle count
- Maintains sterile technique

✔ **NOTE:** Sterility is secondary to resuscitation efforts.

- Assists wherever needed
- If resuscitation measures are unsuccessful, follows hospital policy in regard to death protocol

4. **Surgical technologist/scrub nurse**

- Remains sterile and protects the sterile field
- Should arrest occur during the operative procedure, wound is packed with sterile drapes, and the patient is repositioned for CPR
- If surgeon decides to close wound during resuscitation efforts, closing suture must be accessible.
- Accounts for sponges, needles, and instruments

✔ **NOTE:** Counts are completed and wound is closed despite outcome.

- Attends to the needs of the surgeon and sterile field
- Has syringes of medications filled and ready for use
- If patient is hemorrhaging, keeps suction tubing and suction tips clear and functioning

**OBJECTIVE 27**

**Match OR anesthesia equipment used for delivering anesthetics and/or monitoring the patient with their correct descriptions.**

1. **Anesthesia machine with gas delivery system**—Special machine used to deliver oxygen and anesthetic gases to the patient through a breathing system; has devices for monitoring the blood pressure, electrocardiogram, oxygen levels, and an alarm system to signal apnea or disconnection of the breathing circuit; machine includes a vaporizer, ventilator, rebreathing apparatus, and scavenging system

   ✔ **NOTE:** Hoses, flowmeters, and gas cylinders are color coded to help in identification. Oxygen ($O_2$) is green and nitrous oxide ($N_2O$) is blue.

2. **E.K.G. (electrocardiogram) monitor**—Device for visualizing and recording electrical activity of the heart

3. **Hemodynamic monitors**—Computers that monitor patient's vital functions (ex: blood pressure, heart rate, blood flow, vascular volumes, blood properties, and cardiac function); may be noninvasive or invasive

   ✔ **NOTE:** Noninvasive monitors do not penetrate the body such as sphygmomanometer (blood pressure cuff). Invasive monitors penetrate skin or enter a body cavity. An example is an indwelling catheter which converts the pressure within arteries and veins into electrical activity which is displayed on a monitor screen.

4. **Pulse monitor**—Sensor probe clipped to a pulsating vascular bed (finger, toe, earlobe, or over bridge of nose) that measures arterial hemoglobin oxygen saturation

5. **Temperature monitoring devices**—Devices that monitor patient's temperature during anesthesia using a temperature probe and any of several devices that may display patient's temperature from their skin, esophagus, rectum, blood, etc.

6. **Scale**—Device may be used to weigh sponges containing blood thrown from the surgical field and to estimate the amount of blood lost by the patient

7. **Stethoscopy**—Continuous auscultation of chest sounds to detect pulmonary and cardiac sounds by taping a stethoscope over the precordium (the region over heart and stomach at level of the diaphragm) or by placing a detector within a patient's esophagus (esophageal stethoscope)

8. **Electroencephalographic device**—Device used to monitor the patient's brain wave activity

9. **Pulmonary artery catheter**—May be inserted from the patient's neck through the heart via the right atrium and ventricle and into the pulmonary artery where it measures different pressures that help the anesthetist in the care of the patient; measures venous pressure, pulmonary artery pressure, wedge pressure (similar to left atrial pressure), and cardiac output

10. **Central venous catheter**—May be inserted into the superior vena cava from the patient's neck to allow for the measurement of central venous pressure

11. **System for Anesthetic and Respiratory Analysis (SARA)**—A monitoring device that may be connected to the anesthesia machine that checks the anesthesia gases being delivered in all the operating rooms and records and displays the data in a central location

OBJECTIVE 28

**Match equipment used as adjuncts to anesthesia with their uses.**

1. **Blood warming devices**—Used to warm blood and fluids to body temperature before administration; several different types of blood warming devices may be used
2. **Fluid pumps**—Used to hasten fluid and blood administration by wrapping the plastic fluid or blood bag with a pneumatic device that applies pressure to the blood or fluid bag causing the liquid to flow more rapidly
3. **Infusion control devices**—Uses any of many syringe or roller pumps to help administer fluid or drug containing fluids at variable rates during the administration of anesthesia; these pumps may work with battery power or AC electricity
4. **Double-cuffed pneumatic tourniquet**—Used by the anesthetist or anesthesiologist to keep local anesthetic agents in an extremity during a Bier block (intravenous block)

KEY TERM

**Bier block**—Type of local anesthetic where an extremity is exsanguinated and a tourniquet is inflated to stop blood flow, then a local anesthetic agent is injected into a vein in the arm providing a pain free operating site

OBJECTIVE 29

**List types of thermoregulatory devices used in the operating room.**

✔ **NOTE:** During anesthesia the body loses the ability to regulate temperature, thus temperature can drop many degrees, especially during long, complicated operations. Loss of body temperature slows the metabolism of drugs and can complicate recovery. Very young and very thin people (less body mass to retain heat) are especially susceptible. Many different types of devices are in use to help prevent loss of body heat during surgery.

1. **Thermal drapes**
    - Reflective drapes, similar to the old space blankets, may be placed over areas of the body not involved in the operation to help prevent heat loss during surgery.
    - Drapes should be placed soon after the patient is anesthetized as heat loss begins very soon after the start of the anesthetic.
2. **Plastic bags**
    - One very inexpensive way to prevent heat loss is to place the patient's head in a plastic bag after they have been intubated.
3. **Hypothermia/hyperthermia blankets**
    - An electronic device that circulates cooled or heated liquid through a blanket either under or over the patient; may be used to either heat or cool the patient.
    - Operating room personnel should ensure that the unit has an adequate level of cooling solution and that the blanket is padded to prevent pressure. The desired temperature for the circulation liquid can be set on the unit.

4. **Heat lamps**

- In some cases, heat lamps may be used to provide a warm area in which to operate without warming the entire room.

5. **Fluid/blood warmers**

- Fluids may be warmed before they are connected to the IV tubing or the tubing may be passed through a warming device to warm the fluid on the way to the patient.

  ✔ **NOTE:** Microwave ovens should never be used to warm blood or fluids given to a patient.

6. **Heated gas delivery hoses**

- In some cases, the hoses that deliver the gases from the anesthesia machine may be heated to warm the gases as they are delivered to the patient. This is a very effective way of controlling temperature.

7. **Hot air blankets**

- A unit that heats air and delivers hot air to areas of the patient not involved in the operation may in some cases be selected to warm the patient. Care needs to be taken that the delivery hose does not rest against the patient causing pressure.

✔ **NOTE:** Before placing a thermal regulatory device, familiarize yourself with the safe use of the device and read the directions and cautions provided by the manufacturer. Patients can be burned, overheated, have reactions to adhesives used, as well as several other complications through improper use of these devices.

OBJECTIVE 30

**Complete statements concerning *hemostasis* and blood replacement.**

✔ **NOTE:** When the integrity of a blood vessel is interrupted, chemical factors are released that cause platelets to adhere to the site of the injury and form a plug to stop the loss of blood from the vascular system. With time, fibrinogen is converted to fibrin and a fibrin clot is formed. This fibrin clot is then converted into a firm clot which retracts to form a definitive plug. This clotting mechanism is only effective with smaller blood vessels. When larger vessels are affected, other means are necessary to help stop the loss of blood.

1. **Methods of hemostasis**

- **Hemostatic instruments**—One of many different clamps may be used to temporarily stop the bleeding to allow time for a clot to form or something else to be done to prevent the loss of blood.

- **Ligature**—Absorbable or nonabsorbable ligature may be used to close the opening in the blood vessel; frequently tied around the bleeding vessel after a clamp has been used to stop the bleeding; clamp is removed after the ligature has been tied

- **Pressure**—May be applied to the site of the bleeding while a clamp is obtained or simply held for a few minutes while a clot forms

- **Electrocoagulation**—Electric current may be applied to site of bleeding; electric current causes heat which damages the tissues resulting in physical blockage of the bleeding site

- **Bone wax**—Placed into the bleeding edges of a bone to physically stop the flow of blood
- **Tourniquet**—May be used to stop blood flow in an extremity during surgery
- **Pledgets**—Small sponge on a string used to stop bleeding
- **Hemostatic clips**—Surgeon may elect to use a metal clip to occlude the flow of blood; clips are left in place after they are applied
- **Pharmacologic agents**—Any of several products such as fibrinogen placed on a physical substance such as Gelfoam® to help clot formation

KEY TERM

**Hemostasis**—The arrest of bleeding

2. **Monitoring blood loss**

- Calibrated suction devices
  - Blood or fluids that are suctioned from the operative field are usually collected in a calibrated container to aid in estimation of the amount of blood lost.
  - If the anesthetist is concerned about accurate estimation, it is a good idea for the scrub personnel to measure the volume of irrigant that is used so that the volume aspirated can be subtracted from the total volume of the suction contained to help determine the blood loss.
- Weighing sponges
  - The anesthetist may elect to weigh the sponges containing blood that are thrown from the operative field to help estimate the volume of blood in each sponge. One (1) cc of blood weighs approximately one (1) gram. This is especially useful on very small patients.

3. **Auto transfusion**

- It is becoming popular to collect the blood aspirated from the operative field in a sterile container, wash it to remove impurities, and retransfuse it to the patient at the end of the procedure. It is important to be careful with the sterility of the suction tip when auto transfusion is being used. If the suction is lost off the field, it needs to be clamped or cut as soon as possible to help prevent sucking contaminates into the sterile suction container. Also, if large amounts of irrigation are being used, it may be necessary to suck these into another suction source to lessen the volume needing to be washed.
- A special suction tubing is used with auto transfusion that allows an anticoagulant to be added to the blood to prevent clot formation in the storage container.
- Certain religions may not allow auto transfusions to be used.

- Auto transfusion is expensive, requires special equipment, and should probably not be used unless a large amount of blood loss is expected. It does however lessen the need for bank blood and the dangers associated with this practice.

4. **Blood components**

- Whole blood is collected from donors and contains the red blood cells and the plasma with all of the clotting factors.
- Packed red blood cells involve the collection of whole blood and the separation of red blood cells from the plasma; red blood cells are then given to the patient if there is blood loss; plasma is given if the clotting factors are needed.
- Platelets can be separated from the plasma and given separately if needed.
- Blood components are stored at reduced temperatures and only allowed to warm when they are given. For this reason, they are kept in the blood bank until they are needed for transfusion. Sometimes, if rapid blood loss is expected, the blood can be placed in a cooler by the blood bank and kept in the operating room allowing for more rapid transfusion if needed.
- The patient must be matched with the blood that is going to be given. An identification number is placed on the patient and matched with a number on the blood before administration to assure that the correct blood is given to the correct patient.

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 1-E: Computer Skills

# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 1-E: Computer Skills

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1—Examine Computer Operating Manual(s) for Basic Operating Procedures . . . . 21
2—Examine Word-Processing Software Manual for Basic Operations . . . . . . . . . . 23

Job Sheets

1—Start/Boot the Computer . . . . . . . . . . 27
2—Open and Close a Program . . . . . . . . . . 29
3—Create a Word-Processed Document . . . . . . . . . . 31
4—Format a Word-Processed Document . . . . . . . . . . 33
5—Insert Graphic and Footnote/Endnote in Word-Processed Document . . . . . . . . 37
6—Search the Internet . . . . . . . . . . 41
7—Use E-mail . . . . . . . . . . 43

## Learning Activities Sheet

**PREREQUISITES:** None

Student name ______________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 3.

☐ 5. **Read** Student Supplement 1, "Operating a Mouse."

☐ 6. **Research** Online resources to learn more about basic computer skills. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 7. **Study** Information Sheet, Objective 4 through Objective 7.

☐ 8. **Do** Assignment Sheet 1, "Examine Computer Operating Manual(s) for Basic Operating Procedures."

☐ 9. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 10. If the evaluation is not satisfactory, repeat steps 7 and 8.

☐ 10. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 11. **Do** Job Sheet 1, "Start/Boot the Computer."

☐ 12. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat step 11.

☐ 13. **Study** Information Sheet, Objective 8.

☐ 14. **Observe** Demonstration of procedures to be used in completing Job Sheet 2.

☐ 15. **Do** Job Sheet 2, "Open and Close a Program."

☐ 16. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 17. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat step 15.

☐ 17. **Study** Information Sheet, Objective 9 through Objective 13.

☐ 18. **Do** Assignment Sheet 2, "Examine Word-Processing Software Manual for Basic Operations."

☐ 19. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 20. If the evaluation is not satisfactory, repeat steps 17 and 18.

☐ 20. **Observe** Demonstration of procedures to be used in completing Job Sheet 3 through Job Sheet 5.

☐ 21. **Do** Job Sheet 3, "Create a Word-Processed Document."

☐ 22. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 23. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 3 and repeat step 21.

☐ 23. **Do** Job Sheet 4, "Format a Word-Processed Document."

☐ 24. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 25. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 4 and repeat step 23.

☐ 25. **Do** Job Sheet 5, "Insert Graphic and Footnote/Endnote in Word-Processed Document."

☐ 26. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 27. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 5 and repeat step 25.

☐ 27. **Study** Information Sheet, Objective 14.

☐ 28. **Observe** Demonstration of procedures to be used in completing Job Sheet 6.

☐ 29. **Do** Job Sheet 6, "Search the Internet."

☐ 30. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 31. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 6 and repeat step 29.

☐ 31. **Study** Information Sheet, Objective 15.

☐ 32. **Observe** Demonstration of procedures to be used in completing Job Sheet 7.

☐ 33. **Do** Job Sheet 7, "Use E-mail."

☐ 34. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 35. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 7 and repeat step 33.

☐ 35. **Take** Written Test provided by your instructor.

☐ 36. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 37. If the evaluation is not satisfactory, repeat steps 4, 7, 13, 17, 27, and 31.

☐ 37. **Check** With your instructor for any additional assignments to be completed.

☐ 38. **Do** Additional assignments your instructor lists below.

____________________________________________

____________________________________________

____________________________________________

☐ 39. **Take** Module Review provided by your instructor.

☐ 40. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 41. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to identify the basic components of a computer system and be able to operate a computer utilizing word-processing, Internet browser, and e-mail software. You should demonstrate these competencies by completing the assignment sheets and job sheets and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

✔ **NOTE:** The information presented in this module is intended primarily for Windows-based computer users. Screen shots reprinted by permission from Microsoft Corporation.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. List the uses of computers in the surgical suite.
2. Identify the basic components of a computer system.
3. Match types of input devices to their correct uses.
4. Complete statements concerning output devices.
5. Select true statements concerning computer memory.
6. Match computer storage devices to their correct descriptions.
7. Distinguish between basic computer operating systems.
8. Match terms related to the computer desktop to their correct descriptions.
9. List the characteristics of word-processing software.
10. Match basic word-processing software text-tool operations to their correct functions.
11. Match page-setup features to their correct descriptions.
12. Identify the primary functions of the icons located on a word-processing toolbar.
13. Match the primary functions on a word-processing toolbar to their icons.
14. Complete statements concerning the basics of using the Internet.
15. Select true statements concerning e-mail.
16. Examine computer operating manual(s) for basic operating procedures. (Assignment Sheet 1)
17. Examine word-processing software manual for basic operations. (Assignment Sheet 2)
18. Start/boot the computer. (Job Sheet 1)

19. Open and close a program. (Job Sheet 2)

20. Create a word-processed document. (Job Sheet 3)

21. Practice using the formatting toolbar. (Job Sheet 4)

22. Insert graphic and footnote/endnote in word-processed document. (Job Sheet 5)

23. Search the Internet. (Job Sheet 6)

24. Use e-mail. (Job Sheet 7)

## Information Sheet

**OBJECTIVE 1** **List the uses of computers in the surgical suite.**

1. **To schedule patients in surgery**
2. **To save, update, and print surgeon's preference cards**
3. **To save and update surgical patient's charts**
4. **To save surgical records, such as lab reports**
5. **To order supplies and maintain inventory from sterile processing department**
6. **To perform surgical procedures involving robotics**

**OBJECTIVE 2** **Identify the basic components of a computer system.**

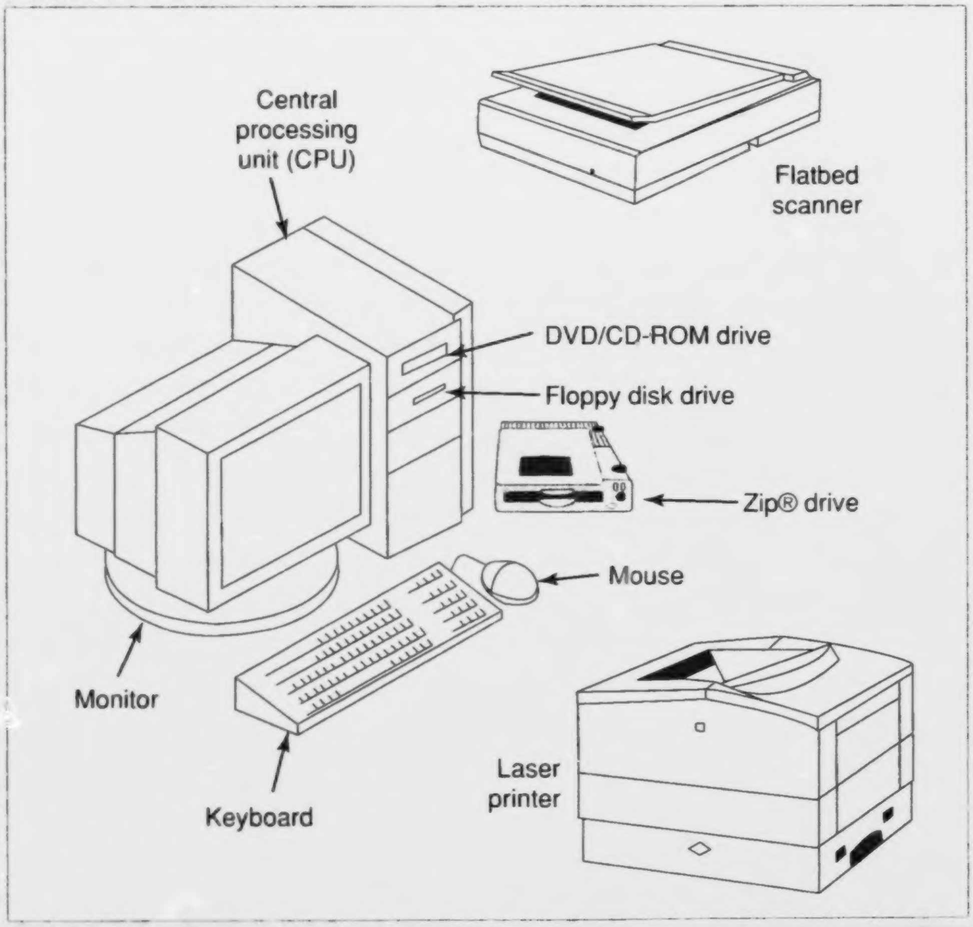

Central processing unit (CPU)
Flatbed scanner
DVD/CD-ROM drive
Floppy disk drive
Zip® drive
Mouse
Monitor
Keyboard
Laser printer

Figure 1
Basic components of a computer system

OBJECTIVE 3

**Match types of input devices to their correct uses.**

1. **Keyboard**—Used to enter information into the computer through the use of keys containing the alphabet, numbers, symbols, and functions

2. **Mouse**—Used to control the on-screen cursor or pointer when selecting items in pull-down menus, moving data, or drawing graphics in application software

   ✔ **NOTE:** A mouse may have one, two, or three buttons, but the left button is usually the "main" mouse button. A mouse can be purchased as a trackball that moves on the desktop or as a fingertip-operated trackball.

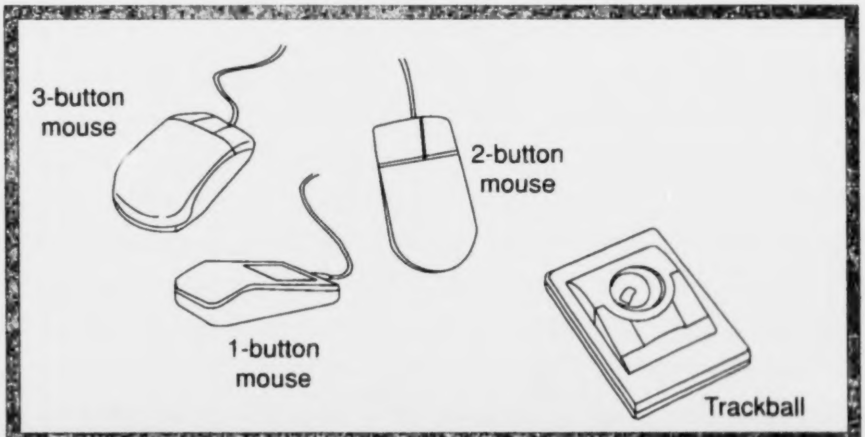


Figure 2
Mouse types

3. **Digital camera**—Used to record video or still images in a digital form rather than on a film negative. Images are transferred to the computer through cables, disks, or cartridges. There is a fixed, maximum resolution that can be recorded.

   ✔ **NOTE:** The use of a digital camera can eliminate the need to scan images for electronic output.

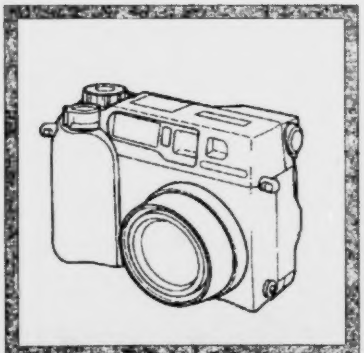


Figure 3
Digital camera

4. **Scanner**—Used to convert art, photos, or text to digital data usable by the computer

✔ **NOTE:** Scanners can reproduce images at reduced, enlarged, or original size and in color or in various shades of gray. Most scanners support optical character recognition (OCR) software used to scan typed text.

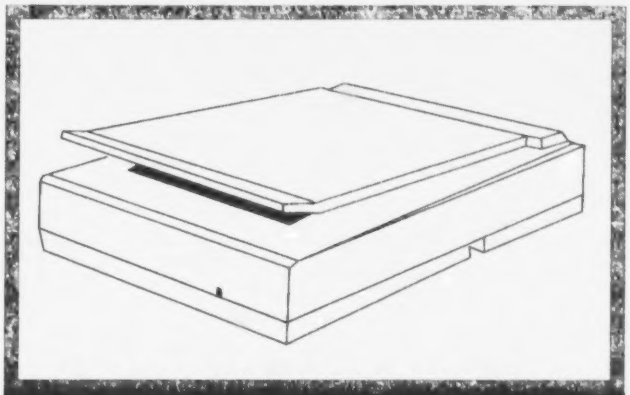


Figure 4
Scanner

OBJECTIVE 4

**Complete statements concerning output devices.**

1. **Monitor**—Displays graphics and text on a screen
    - Monitors are available in various types and sizes and should be selected according to the intended use.
    - Monitors are sold by size of screen measured diagonally from corner to corner.
2. **Speakers**—Distributes sound from computer programs and files
    - Speakers can be internal or external, depending on the computer workstation.
    - Volume can be controlled through setting on taskbar or externally on actual speaker.
3. **Printers**
    - **Laser printer**—Uses intense light and toner to transfer (or draw) images on paper; supplies a **resolution** of 300 dpi or greater
    - **Inkjet printer**—Forms characters and graphics by spraying ink on paper; supplies near-laser-quality resolutions

KEY TERM

**Resolution**—The density of dots or pixels on a page or monitor usually measured in dots per inch (dpi)

**OBJECTIVE 5** **Select true statements concerning computer *memory*.**

1. **Central processing unit (CPU)**—Performs arithmetic and logical operations and decodes and executes instructions

   - CPUs are measured in megabytes (MB) of memory. The higher the MB, the faster the computer performs.

   ✔ **NOTE:** The CPU is often referred to as the "brain" of the computer.

2. **RAM (Random Access Memory)**—Temporary memory that stores data and programs while computer is in use

   ✔ **NOTE:** The computer system must have a minimum RAM capacity that is large enough to accommodate the system's software requirements.

3. **ROM (Read Only Memory)**—Used by the computer's operating system; ensures that the system memory runs

KEY TERM

**Memory**—Portion of computer that stores information and software while the machine is on; measured in bytes; byte = 1 character; kilobyte (KB) = 1,024 bytes; megabyte (MB) = 1,024 KB; gigabyte (GB) = 1,024 MB

**OBJECTIVE 6** **Match computer storage devices to their correct descriptions.**

1. **Hard drive**—Device used to read, write, and store data on a hard, magnetic disk located inside the computer

   - The C: drive is usually assigned to the hard drive.

   ✔ **NOTE:** Hard drives can be either internal or external. Most hard drives are permanent and located inside the CPU; however, removable hard drives are available.

2. **Floppy disk drive**—Device used to read from and write information to floppy diskettes

   - The floppy disk drive is usually assigned to the A: drive.
   - Floppy disks can hold anywhere from 760 K to 2.8 MB of data depending on the density of the disk.

3. **CD-ROM (compact disc) drive**—Mechanism designed to turn a CD in the presence of a laser beam and photo diode detector to read information encoded on the CD

   - The CD-ROM drive is usually assigned to the D: drive.
   - CDs can hold 650–700 MB of data.

4. **DVD (digital video disc) drive**—Digital video disc player that can read DVDs and CDs. DVD technology allows video, audio, and computer data to be encoded onto a CD.

   - DVDs can store up to 7 GB of data.

5. **Removable drive**—Storage device that uses some type of disk or cartridge for storing and transporting large files such as documents containing graphics

   Examples: Zip®, Jaz®, rewritable CD-ROM drives, recordable CD-ROM drives

   - Removable drives are often assigned to the E: drive.

   ✓ **NOTE:** Zip® disks can store 100–250 MB of data depending on the type of Zip® disk.

OBJECTIVE 7 **Distinguish between basic computer *operating systems*.**

1. **Macintosh Operating System (Mac OS)**—Designed for Apple's numerous personal computer models
2. **Windows**—Provides a graphics-based operating environment for PC users

KEY TERM

**Operating system**—Computer program responsible for housekeeping and establishing communications between disk storage device, computer, and printer; tells computer how to manipulate information

**OBJECTIVE 8** **Match terms related to the computer desktop to their correct descriptions.**

1. **Desktop**—On-screen work area that uses icons and menus to simulate the top of a desk. Enables users to move pictures of objects and to start and stop tasks in much the same way as they would if they were working on a physical desktop.

   - **Taskbar**—Area that displays all programs currently open; contains start menu from which computer programs can be opened and new software can be loaded; contains the settings menu from which numerous computer preferences may be changed
   - **Recycle bin**—Location where deleted files are stored until emptied
   - **Wallpaper**—Background design of desktop; can be changed to various pictures, designs, colors, etc.

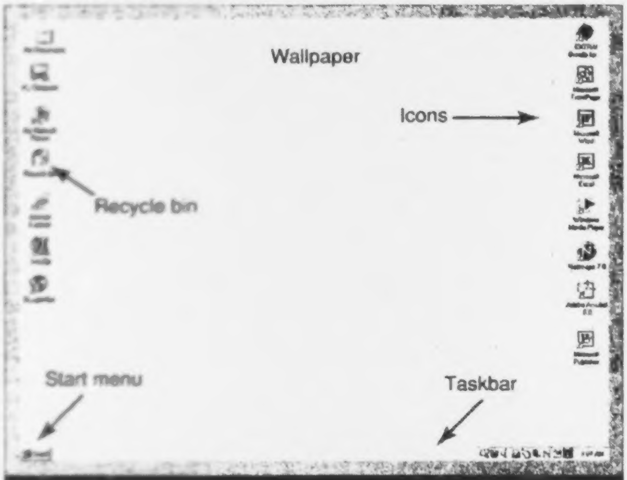


Figure 5
Desktop

2. **Toolbar**—A row, column, or block of on-screen buttons or icons that activate certain functions when clicked on with the mouse

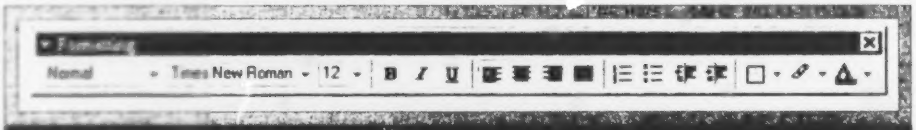


Figure 6
Toolbar

3. **Program**—Instructions that make the computer perform the tasks for which people use computers; designed to assist in the performance of a specific task, for example, word processing, accounting, or inventory management.

   ✔ **NOTE:** Computer programs are also referred to as "software."

OBJECTIVE 9

**List the characteristics of word-processing software.**

1. **Allows input of large amount of text**
2. **Provides formatting features, such as setting tabs and margins**
3. **Provides editing features, such as moving, copying, inserting, and deleting text**
4. **Provides a spell-check feature**
5. **Provides a thesaurus to search for synonymous words**
6. **Provides a grammar check**
7. **Provides search-and-replace feature for words, letters, numbers, and phrases**
8. **Provides a merge feature to individualize documents, such as form letters, by combining the document file with data files, such as names and addresses**

KEY TERM

**Spell-check**—Computerized dictionary that checks proper spelling and prompts the operator if a misspelled word is located or if that word is not found in the dictionary

OBJECTIVE 10

**Match basic word-processing software text-tool operations to their correct functions.**

1. **Type text**—To input text
2. **Edit text**—To delete, insert, or rearrange text
3. **Cut and paste text**—To mark text so that it will be removed from its current position, temporarily stored in the computer's memory, and then retrieved in another position
4. **Copy and paste text**—To mark text so that it will be left in its current position, while a copy is temporarily stored in the computer's memory, and then retrieved in another position
5. **Move or adjust text**—To rearrange an area of text that is defined by boundaries

OBJECTIVE 11

**Match page-setup features to their correct descriptions.**

1. **Margin settings**—Dialog box for setting left, right, top, and bottom page limits
2. **Page orientation**—Dialog box for selecting either portrait (tall) or landscape (wide) page position

   ✔ **NOTE:** Text on a portrait page orientation will be printed from left to right across the width of the page. Text on a landscape page orientation will be printed from left to right across the length of the page.

3. **Columns**—Dialog box for creating either equal- or unequal-size column positions and numbers

4. **Pagination**—Page numbering within a document
5. **Templates**—Permanent page formats that can be copied and used repeatedly
6. **Footnotes and endnotes**—Text placed either at the bottom of a page or at the end of a document to show resources used in creation of document

OBJECTIVE 12

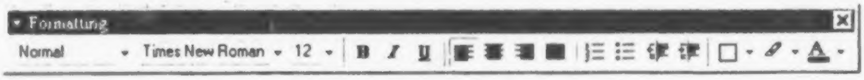
**Match paragraph-specification features to their correct functions.**

1. **Text wrap**—Option selected to adjust the placement of text around graphics
2. **Alignment**—Option selected to position text flush left, flush right, centered, or justified
3. **Tabs and indents**—Options selected to align text lines in specific increments left, right, center, decimal, or dot leader
4. **Paragraph-specifications**—Options selected to make either global or individual changes to a selection including any of the various paragraph-specification features such as hyphenation, alignment, space before and after, and indents

OBJECTIVE 13

**Identify the primary functions of the icons located on a word-processing toolbar.**

✔ **NOTE:** You may customize toolbars to contain many variations of functions. This objective only covers the most basic of these functions in Microsoft Word®.

| Functions | Icons | Functions | Icons |
|---|---|---|---|
| Open file | 📂 | Cut | ✂ |
| Create a new file | 🗋 | Copy | 🗐 |
| Save a file | 💾 | Paste | 🖌 |
| Print | 🖨 | Undo | ↶ |
| | | Zoom | 100% ▾ |
| Formatting |  Formatting<br>Normal<br>Times New Roman<br>12<br>B<br>I<br>U<br>A | | |

**OBJECTIVE 14** **Complete statements concerning the basics of using the Internet.**

1. **You must have an account with an Internet Provider (IP) to access the Internet.**

   ✔ **NOTE:** IPs are available through local or national companies.

2. **In order to access the Internet, your computer must have Internet browser software installed.**

   Examples: Internet Explorer® and Netscape Navigator®

3. **The home page is the first page that appears when the Internet browser is opened. The Home button on the browser will always return the user to this page.**

4. **The Forward and Back buttons allow the user to move back and forth between pages in a Web site.**

5. **The Refresh (or Reload) button is used to reload the page the user is currently viewing.**

6. **The Stop button stops the current page from loading.**

7. **The Bookmarks (or Favorites) allows the user to save a web address in their browser for viewing at a later time.**

   ✔ **NOTE:** Internet Explorer and Netscape Navigator sometimes use different terminology for the same function. For example, Explorer uses the term "Favorites" and Navigator uses the term "Bookmarks."

8. **When conducting research on the Internet, use a *search engine* to search for specific topics. The browser contains a search function that will connect directly to one of these search engines.**

   Examples: Yahoo, Google, and AltaVista

9. **Computers should be equipped with either an internal or external modem in order to connect to the Internet via a telephone line.**

   ✔ **NOTE: There are many technologies available that offer faster Internet service such as DSL or cable modem. Hospitals and businesses are generally connected to the Internet via T1 and DS3 dedicated phone lines.**

KEY TERM

**Search engine**—Web site that helps the user conduct a search for a specific topic

**OBJECTIVE 15**

**Select true statements concerning *e-mail*.**

1. **To send and receive e-mail, you must have an e-mail address.**

   ✔ **NOTE:** E-mail addresses are available for free through Web sites, such as Yahoo or Hotmail. Or, you could purchase e-mail software, such as Microsoft Outlook.

2. **E-mail addresses are composed of a personalized name/user ID followed by the @ symbol and then the Internet/e-mail provider name.**

   Example: janedoe@yahoo.com

3. **Common e-mail functions**

   - Compose e-mail
   - Send e-mail
   - Receive e-mail
   - Save e-mail
   - Forward e-mail
   - Delete e-mail
   - Attach files to e-mails (attachments)
   - Store names and e-mail addresses in the address book

KEY TERM

**E-mail**—Electronic mail sent via the Internet

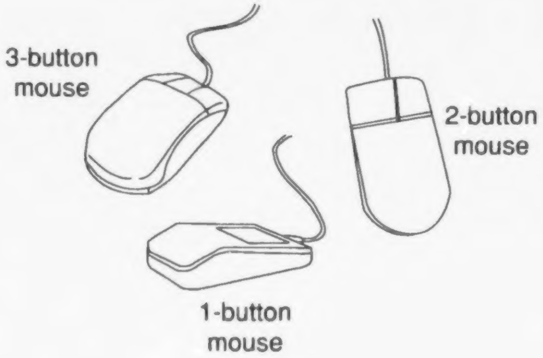
## Student Supplement 1—Operating a Mouse

To operate software, you must know how to use a mouse and understand terms associated with mouse operations.

A mouse may have one, two, or three buttons, but the left button is usually the "main" mouse button. As the mouse is moved across a work surface, a pointer moves across the monitor screen. The shape of the pointer may change as different tasks are selected.

It is important to be familiar with the following basic mouse operations when working with software.

- Point—To move the tip of the pointer on top of an item on the monitor screen
- Click—To quickly press and then release mouse button
- Double-click—To quickly press and then release mouse button twice in quick succession
- Drag—To hold down mouse button while moving mouse to reposition pointer
- Select—To point on a menu or graphic item or to highlight text and then click or drag mouse so that text will be affected by the next action taken



OBJECTIVE 16

## Assignment Sheet 1—Examine Computer Operating Manual(s) for Basic Operating Procedures

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Directions were followed ______
- Instructions properly recorded ______

**Overall rating** ______

Evaluator's comments ______________________________

**Materials list**

- Computer operating manual

**Directions**

Examine the operating manuals for the Windows-based computers used on site. Read the operating procedures for starting and shutting down the computer. Record the instructions for these procedures on the blank lines provided.

1. Start/boot a Windows-based computer ______________________________
2. Shut down a Windows-based computer ______________________________

BEST COPY AVAILABLE

**OBJECTIVE 17**

## Assignment Sheet 2—Examine Word-Processing Software Manual for Basic Operations

Name ______________________ Date ____________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Instructions were recorded correctly | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________

---

**DIRECTIONS**

Examine the word-processing software manual for the software used on-site. Read the instructions for the following operations and record the instructions for those operations on the blank lines provided below.

1. Create a file ______________________

2. Open a file ______________________

3. Close a file

4. Save a file

5. Set margins

6. Set tabs and indents

7. Type text

8. Edit text

9. Cut and paste text

10. Copy and paste text

11. Change type size

12. Change font

13. Add character style attributes (bold, underline, small caps, etc.)

14. Align text (left, right, center, justified)

15. Create numbered and bulleted lists

16. Set up columns (equal and unequal)

17. Create footnotes and endnotes

18. Set pagination

19. Insert graphics/clip art

**OBJECTIVE 18**

# Job Sheet 1—Start/Boot the Computer

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Computer started and monitor turned on properly | ______ |
| • Computer shut down and monitor turned off properly | ______ |
| **Overall rating** | ______ |

Evaluator's comments ____________________________________________

**Tools, equipment, and materials**

- Computer workstation
- Operating-system software manual
- Assignment Sheet 1

**PROCEDURE**

☐ 1. Start/Boot the computer and turn on monitor according to operating procedures recorded in Assignment Sheet 1.

☐ 2. Check monitor for disk- or system-error messages.

✔ **NOTE:** Computer systems vary, but many will display an introductory message and conduct self-tests that notify you of any disk or system errors that may occur during startup.

☐ 3. If errors messages appear, notify the instructor immediately and correct the error(s).

☐ 4. After completing successful startup, exit program to properly close any files, shut down computer according to operating procedures recorded in Assignment Sheet 1, and turn off monitor.

Evaluator's Comments: ____________________________________________

## Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 1-E: Computer Skills

OBJECTIVE 19

# Job Sheet 2—Open and Close a Program

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | _____ |
| • Computer started and monitor turned on properly | _____ |
| • Program was opened properly | _____ |
| • Program was closed properly | _____ |
| • Computer shut down and monitor turned off properly | _____ |
| **Overall rating** | _____ |

Evaluator's comments ______________________________________________

_______________________________________________________________

_______________________________________________________________

---

**Tools, equipment, and materials**

- Computer workstation with word-processing software loaded

✔ **NOTE:** The following steps are for a Windows-based computer.

PROCEDURE

☐ 1. Start the computer. Wait for the desktop to fully load.

☐ 2. Use your mouse to place the arrow over the "Start" button in the lower-left-hand corner of the desktop.

☐ 3. Click the left mouse button once. A menu will appear listing several options.

☐ 4. Move the arrow over the menu option that says "Programs." Another menu will appear listing all the programs loaded on the computer.

☐ 5. Move the arrow until the word-processing program (such as Microsoft Word) is highlighted.

☐ 6. Click the left mouse button once to open the program.

☐ 7. Click on the "X" button in the upper-right-hand corner of the program to close it, or use your mouse to choose "File," "Exit" from the menu bar.

☐ 8. Shut down the computer.

Evaluator's Comments: ______________________________

______________________________

______________________________

OBJECTIVE 20

## Job Sheet 3—Create a Word-Processed Document

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- Computer and printer turned on properly ______
- Text entered properly ______
- File saved and printed ______
- Quit software and exited system properly ______
- Computer shut down and monitor turned off properly ______

**Overall rating** ______

Evaluator's comments ______________________________________

---

INSTRUCTIONS

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

EQUIPMENT AND MATERIALS

- Computer workstation with word-processing software loaded
- Removable media such as floppy disk, Zip desk, etc. (Optional)
- Assignment Sheets 1 and 2

PROCEDURE

✓ **NOTE:** The steps in this procedure should be modified to comply with the word-processing software and computer equipment available.

☐ 1. Boot computer according to operating procedures recorded in Assignment Sheet 1.

☐ 2. Turn on the printer.

☐ 3. Open the word-processing program.

☐ 4. Create new file, completing document setup, if required.

☐ 5. Enter the following text.

> The primary goal of surgical intervention is to allow the patient to return to his/her best possible state of physical and mental health.
>
> It is recognized that not every patient will return to a state of wellness due to the nature of some terminal illnesses. In these cases, the health team members will work together to ease the patient's pain and discomfort.

☐ 6. Spell check the document by selecting "Spelling and Grammar" from the Tools menu.

✔ **NOTE:** Keep in mind that the spell check feature will not catch words that are misused but spelled correctly. For this reason, it is important to proofread your work.

☐ 7. Save file and store on hard drive or removable media, such as a floppy disk or Zip disk.

☐ 8. Print document and write your name and "Job Sheet 3" at top of printed page.

☐ 9. Close file and exit word-processing software.

☐ 10. Shut down computer.

☐ 11. Submit printed page to your instructor for evaluation.

Evaluator's Comments: ______________________________

______________________________

______________________________

**OBJECTIVE 21**

# Job Sheet 4—Format a Word-Processed Document

Name ______________________ Attempt number ____________

Date ______________________ Overall rating ____________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Text aligned as specified | ______ |
| • Type specification set as specified | ______ |
| • Numbered list created as specified | ______ |
| • Text copied and pasted as specified | ______ |
| • Text cut and pasted as specified | ______ |
| • Line spacing set as specified | ______ |
| • Hanging indent set as specified | ______ |
| • Pagination set as specified | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

---

**INSTRUCTIONS** When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Computer workstation with word-processing software loaded
- Printer
- File created in Job Sheet 3

**PROCEDURE**

✔ **NOTE:** The steps in this procedure should be modified to comply with the word-processing software and computer equipment available.

☐ 1. Start the computer.

☐ 2. Turn on the printer.

☐ 3. Open word-processing program.

☐ 4. Open file created in Job Sheet 3.

☐ 5. **Select text alignment**

- ☐ a. Place the cursor at the beginning of the first sentence of the first paragraph.
- ☐ b. Type "Surgical Intervention."
- ☐ c. Press Enter key twice.
- ☐ d. Highlight "Surgical Intervention" by using your mouse.
- ☐ e. Click on the Center button located on the Formatting toolbar. "Surgical Intervention" should now be centered above the two paragraphs.
- ☐ f. Practice highlighting "Surgical Intervention" and change its alignment from center, to left alignment, to right alignment, and back to center alignment.

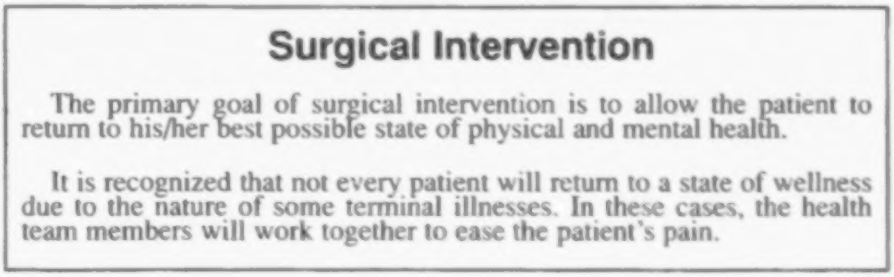
☐ 6. **Select type specifications**

Note: Type specifications can include the following:

- Style—Normal, bold, italic, underline, etc.
- Font—Helvetica, Courier, Times Roman, etc.
- Font size—6, 8, 10, 12, 14 points, etc.
- Case—Upper/lowercase, all caps, small caps, etc.
- Position—Normal, superscript, subscript

- ☐ a. Highlight "Surgical Intervention."
- ☐ b. Select Helvetica from the font menu located on the Formatting toolbar.
- ☐ c. Select 16 pt as the font size from the Formatting toolbar.
- ☐ d. Select bold from the Formatting toolbar.

Your document should now look like this:



**Surgical Intervention**

The primary goal of surgical intervention is to allow the patient to return to his/her best possible state of physical and mental health.

It is recognized that not every patient will return to a state of wellness due to the nature of some terminal illnesses. In these cases, the health team members will work together to ease the patient's pain.

☐ 7. **Create numbered lists**

- ☐ a. Position the cursor at the end of the last line of the last paragraph of your document.

- ☐ b. Press the Enter key four times.
- ☐ c. Click on the numbered list button located on the Formatting toolbar. "1." should now appear on the screen.
- ☐ d. Type the following list, pressing Enter at the end of each line.

  Diagnostic
  Palliative
  Prophylactic (preventive)
  Restorative (curative)

  ✔ **NOTE:** This same procedure can be followed to create bulleted lists.

☐ 8. **Copy and paste text**

- ☐ a. Copy the four lines that you just typed by highlighting these four lines using the mouse and by either selecting "Copy" from the Edit menu or by using the keystroke Control-C.
- ☐ b. Paste these four lines of text by positioning the cursor wherever you would like the text to be pasted in the document and by either selecting "Paste" from Edit menu or by using the keystroke Control-V.

  ✔ **NOTE:** By copying text, the original text remains the same. It is simply copied and pasted in a new location.
- ☐ c. Use the mouse to highlight the four lines that you just pasted.
- ☐ d. Click on the numbered list button to turn off numbering.

☐ 9. **Cut and paste text**

- ☐ a. Highlight "(curative)" from the last list that you just copied and pasted.
- ☐ b. Cut this word by either selecting "Cut" from the Edit menu or by using the keystroke Control-V.

  ✔ **NOTE:** Notice that ."(curative)" is no longer located on the screen.
- ☐ c. Paste this text by positioning the cursor wherever you would like the text to be pasted in the document and by either selecting "Paste" from Edit menu or by using the keystroke Control-V.

  ✔ **NOTE:** By cutting text, the original text is moved and pasted in a new location.

☐ 10. **Set line spacing**

  ☐ a. Highlight the four lines of text that you copied and pasted in step 8.

  ☐ b. Select "Paragraph" from the Format menu located at the top of the screen.

  ☐ c. Change the line spacing to double.

  ✔ **NOTE:** The four lines of text should now appear double-spaced.

☐ 11. **Set hanging indent**

  ☐ a. Highlight the first paragraph of your document. If there is a tab at the beginning of this sentence, delete the tab.

  ☐ b. Select "Paragraph" from the Format menu located at the top of the screen.

  ☐ c. Under "Special indentation," select "hanging."

  ✔ **NOTE:** The second line should now be indented while the first line remains flush with the left margin.

☐ 12. **Set pagination**

  ☐ a. Select "Insert Page Numbers" from Insert menu located at the top of the screen.

  ☐ b. Check the following boxes: Position—Bottom of page (footer); Alignment—Right.

  ☐ c. Check the "Show Number on First Page" box.

  ☐ d. Click on the "Format" button. Number format should be 1, 2, 3.

☐ 13. Print the page; write your name and "Job Sheet 4" at the top of the printed page.

☐ 14. Save file.

☐ 15. Close file, quit the word-processing program, and turn off computer.

☐ 16. Submit job to instructor for evaluation.

Evaluator's Comments: ______________________________

______________________________

______________________________

# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 1-E: Computer Skills

OBJECTIVE 22

## Job Sheet 5—Insert Graphic and Footnote/ Endnote in Word-Processed Document

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- Graphics inserted as specified ______
- Footnote or endnote inserted as specified ______

**Overall rating** ______

Evaluator's comments ______________________________________

---

INSTRUCTIONS

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

EQUIPMENT AND MATERIALS

- Computer workstation
- Word-processing software
- Printer
- File created in Job Sheet 4

PROCEDURE

✔ **NOTE:** The steps in this procedure should be modified to comply with the word-processing software and computer equipment available.

☐ 1. Start the computer.

☐ 2. Turn on the printer.

☐ 3. Open word-processing program.

☐ 4. Open file created in Job Sheet 4.

☐ 5. **Insert a graphic**

    ☐ a. Place the cursor at a point in the document where you would like to insert a graphic.

☐ b. Select "Insert," then "Picture" from the menu at the top of the screen. Another menu will appear asking if you want to select a picture from a file or from clip art. Select "Clip Art."

☐ c. Select a category of clip art from the Insert Clip Art menu by clicking on it once.

☐ d. Choose a picture from that category and click on it. A menu will appear, click on "Insert Clip."

☐ e. Click on the "X" in the upper right corner of the window to close the Insert Clip Art window.

✔ **NOTE:** The clip art you chose should have been inserted in the document. You can move the clip art to a different location by clicking on it, holding down the left mouse button and using your mouse to move it. You can also resize it by clicking on one of the black boxes in the corner of the clip art and holding down your left mouse button while moving your mouse to make the clip art bigger or smaller.

☐ f. Save the document.

☐ 6. **Insert a footnote or endnote**

✔ **NOTE:** Footnotes and endnotes are used for documenting sources used in a document.

☐ a. Place the cursor after the text you would like to footnote/endnote.

☐ b. Select "Insert," then "Footnote" from the menu at the top of the screen. A menu will appear called "Footnote and Endnote."

☐ c. Select Footnote or Endnote. Make sure "AutoNumber" is selected.

☐ d. Type the following text in the box located at the bottom of the screen:

| |
|---|
| *Introduction to Surgical Technology*, MAVCC, Stillwater, OK, 2003, pg. 25. |

☐ e. Click on the "Close" button when you are finished. A number will be inserted at the point in the text you selected earlier.

☐ f. Save the document.

☐ g. Print the document. Write your name and "Job Sheet 5" at the top of the page.

☐ 7. Close the file, quit the word-processing program, and turn off the computer.

☐ 8. Submit the printed document to your instructor for evaluation.

Evaluator's Comments: ______________________________

**OBJECTIVE 23**

## Job Sheet 6—Search the Internet

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

| Evaluation criteria | Rating |
|---|---|
| • Directions were followed | ______ |
| • Internet searched properly | ______ |
| **Overall rating** | ______ |

Evaluator's comments ____________________________________________

**INSTRUCTIONS** When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Computer workstation with Internet browser software loaded
- Internet service
- Printer

**PROCEDURE**

✔ **NOTE:** The steps in this procedure should be modified to comply with the Internet browser and computer equipment available.

☐ 1. Start the computer.

☐ 2. Turn on the printer.

☐ 3. Open the Internet browser.

☐ 4. Type the following address: http://www.google.com in the address bar located at the top of the screen and press "Enter" on the keyboard.

✔ **NOTE:** The Google site should open. Your cursor will be blinking in a box on the page.

☐ 5. Type the following: "Surgical Technology Career" in the box on the screen and click the Google Search box or press "Enter" on the keyboard.

✔ **NOTE:** Placing the words or phrase in quotes ensures that you will get more exact matches for your search.

☐ 6. Print the list of related Web sites that is displayed on your screen. To access any of the Web sites, place your cursor over the highlighted link and click the mouse button. Use the Back and Forward buttons to navigate through the Web sites.

☐ 7. Write your name and "Job Sheet 6" at the top of the printed page of Web sites.

☐ 8. Close the browser and turn off the computer.

☐ 9. Submit the printed page to your instructor for evaluation.

Evaluator's Comments: ____________________

____________________

____________________

**OBJECTIVE 24**

## Job Sheet 7—Use E-mail

Name ______________________ Attempt number ______________

Date ______________________ Overall rating ______________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- E-mail opened properly ______
- E-mail replied to successfully ______
- E-mail forwarded successfully ______
- E-mail composed and sent successfully ______

**Overall rating** ______

Evaluator's comments ______________________________________

---

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Computer workstation with e-mail software loaded (could be included with Internet browser software)
- Internet service
- Printer

**PROCEDURE**

✔ **NOTE:** The steps in this procedure should be modified to comply with the e-mail program and computer equipment available.

☐ 1. Start the computer.

☐ 2. Turn on the printer.

☐ 3. Open the e-mail program.

✔ **NOTE:** You may need to open the Internet Browser first to access the e-mail program.

☐ 4. **Compose a new e-mail message**

- ☐ a. Click the "New Message" icon.

  ✔ **NOTE:** Different programs use different terminology. You may see "Compose," "Create New Mail," "Create New Message," or a variation of these.

- ☐ b. Type the address of the person you wish to send the message to in the "To:" box.

  ✔ **NOTE:** You may choose to e-mail a fellow classmate so that each of you will have a new e-mail message in order to complete the remaining steps of this job sheet.

- ☐ c. Press the "Tab" key on the keyboard to move to the "Subject" box and type in the subject of your e-mail.
- ☐ d. Press "Tab" again to move to the "Message" box and type your message.
- ☐ e. Click the "Send" icon to send your message.

☐ 5. **Open a new e-mail message**

- ☐ a. Click "Inbox" if the inbox screen does not open automatically.

  ✔ **NOTE:** Unread messages will be in bold type.

- ☐ b. Double-click on the message to read it.
- ☐ c. Print the message by clicking on the "Print" icon or selecting "File" and "Print" from the menu at the top of the message. Write your name and "Job Sheet 7" at the top of the printed page.

☐ 6. **Reply to an e-mail message**

- ☐ a. Open an existing e-mail message by double-clicking on it.
- ☐ b. Click the "Reply" button.

  ✔ **NOTE:** You will have the option to "Reply to Sender" or "Reply to All." Use "Reply to Sender" to reply only to the person who sent you the e-mail. Use "Reply to All" to reply to the sender AND all of the people who received the e-mail originally.

- ☐ c. Type your reply in the box provided.
- ☐ d. Click the "Send" button.

☐ 7. **Forward an e-mail message**

- ☐ a. Open an existing e-mail message by double-clicking on it.
- ☐ b. Click the "Forward" button.
- ☐ c. Type the e-mail address of the person you wish to forward the message to in the "To" box.

  ✔ **NOTE:** You can move between the boxes using the "Tab" key on the keyboard.

- ☐ d. Click the "Send" button.

☐ 8. **Delete an e-mail message**

✔ **NOTE:** You may also delete an open e-mail by simply clicking the "Delete" button.

- ☐ a. Open the Inbox.
- ☐ b. Click the box to the left of the e-mail you wish to delete.
- ☐ c. Click "Delete" button.

  ✔ **NOTE:** Deleted e-mails go into the "trash" folder until the computer automatically empties the trash or you select "empty trash."

☐ 9. **Add contact to address book**

✔ **NOTE:** There are various ways to add people to your e-mail address book. Following is the most basic way. Keep in mind that your e-mail software may use different terminology for these buttons, but the end result will be the same.

- ☐ a. Click "Addresses" button.
- ☐ b. Click "Add contact" button.
- ☐ c. Type name of person you wish to add and their e-mail address into appropriate boxes.
- ☐ d. Click "Save Contact."

Evaluator's Comments: ______________________________

______________________________

______________________________

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 2-E: Electricity

## Module Contents

**COMPONENTS**

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Assignment Sheet

1—Evaluate Surgical Applications of Electricity . . . . . . . . . . . . . . . . . . . . . . . . . . 21

Job Sheet

1—Position Grounding Pad and Connect Electrosurgical Unit . . . . . . . . . . . . . . . . . 23

# Introduction to Surgical Technology
# Section E: Biomedical Science
# Module 2-E: Electricity

**PREREQUISITES:**
**None**

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning the following learning activities.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objective 1 through Objective 22.

☐ 5. **Research** Online resources to learn more about basic electricity. Your instructor will list several Web sites on the blanks below. Visit at least three of the following Internet sites.

• ______________________________
• ______________________________
• ______________________________
• ______________________________
• ______________________________
• ______________________________
• ______________________________

☐ 6. **Do** Assignment Sheet 1, "Evaluate Surgical Applications of Electricity."

☐ 7. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat steps 6 and 7.

☐ 8. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 9. **Do** Job Sheet 1, "Position Grounding Pad and Connect Electrosurgical Unit."

☐ 10. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 11. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat step 9.

☐ 11. **Take** Written Test provided by your instructor.

☐ 12. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat step 4.

☐ 13. **Check** With your instructor for any additional assignments to be completed.

☐ 14. **Do** Additional assignments your instructor lists below.

______________________________________________

______________________________________________

______________________________________________

☐ 15. **Take** Module Review provided by your instructor.

☐ 16. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 17. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the assignment sheet, job sheet, Written Test, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to define electricity and identify components of an electrosurgical system. You should demonstrate these competencies by completing the assignment and job sheet and by scoring a minimum of 85 percent on the Written Test and on the Module Review.

✔ **NOTE:** Refer to *Module 2-B: Workplace Safety* for information on electrical safety.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Define *electricity*.
2. Complete statements concerning the structure of matter.
3. Select true statements concerning the principles of electron flow.
4. Complete statements concerning the basic sources of electrical generation.
5. Select true statements concerning magnetism.
6. Complete statements concerning electromagnetism.
7. Match terms related to electrical current with their correct descriptions.
8. Select true statements concerning measuring electricity.
9. State Ohm's law.
10. State the formula for Ohm's law.
11. List the uses of Ohm's law.
12. Match the wires contained in an electrical receptacle with their correct descriptions.
13. Complete statements concerning wall outlets and plugs commonly used in the operating room.
14. List the primary equipment used in surgery that requires electricity to function.
15. List the major causes of electrical accidents.
16. Complete statements concerning facts about electrical shock.
17. Select true statements concerning static electricity.
18. Complete statements concerning grounding operating room electrical equipment.
19. Identify the components of an electrosurgery system.

20. Match electrosurgery components to their correct descriptions.
21. Distinguish between types of electrosurgery units.
22. Complete statements concerning safeguards for using electrosurgery units.
23. Evaluate surgical applications of electricity. (Assignment Sheet 1)
24. Position grounding pad and connect electrosurgical unit. (Job Sheet 1)

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## Information Sheet

OBJECTIVE 1 **Define *electricity*.**

- **Electricity**—A form of energy related to the atomic structure of matter; invisible energy

OBJECTIVE 2 **Complete statements concerning the structure of matter.**

1. **Matter is anything that occupies space and has weight.**
2. **Matter can be a solid, liquid, or gas.**
3. **All matter is made up of elements.**

   Examples of elements: Nitrogen, oxygen, iron, copper, zinc, etc.
4. **There over 100 elements in the periodic table of elements.**
5. **Two or more elements combined make up what is called a compound.**

   Example: Water is a compound consisting of hydrogen and oxygen.
6. **Compounds can be broken down into molecules.**

   Example: One molecule of water contains two hydrogen atoms and one oxygen atom.
7. **Molecules are made up of atoms.**

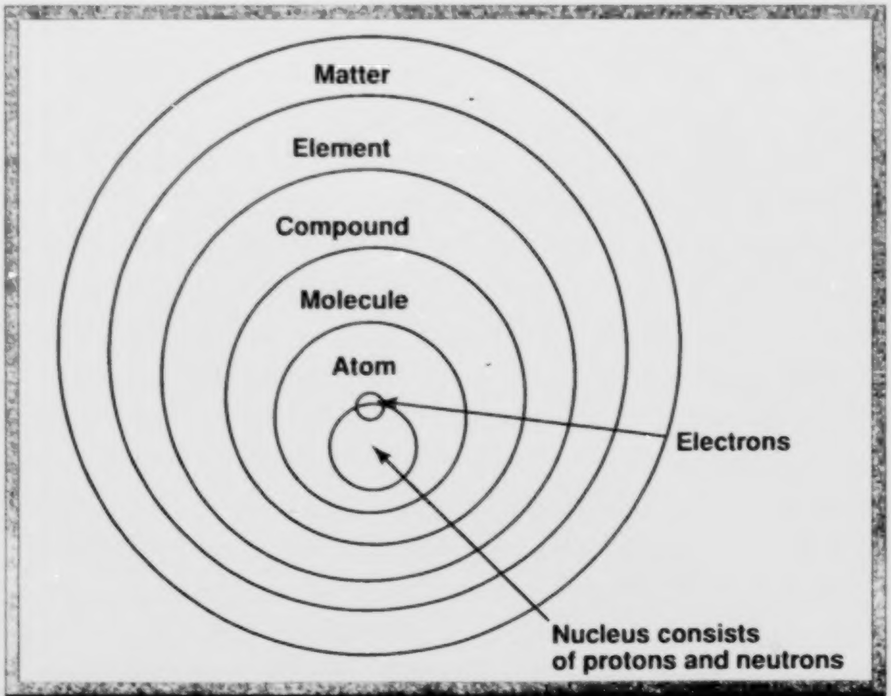

Figure 1
Structure of matter

**OBJECTIVE 3** Select true statements concerning the principles of *electron flow.*

1. **Atoms contain protons, electrons, and neutrons.**
2. **Protons always have a positive charge.**
3. **Electrons always have a negative charge.**
4. **Neutrons always have a neutral charge.**
5. **The nucleus is the center of an atom and consists of protons and neutrons.**
6. **Electrons orbit around the nucleus of an atom. The negatively-charged electron attracts the positively-charged proton, thus holding the atom together.**

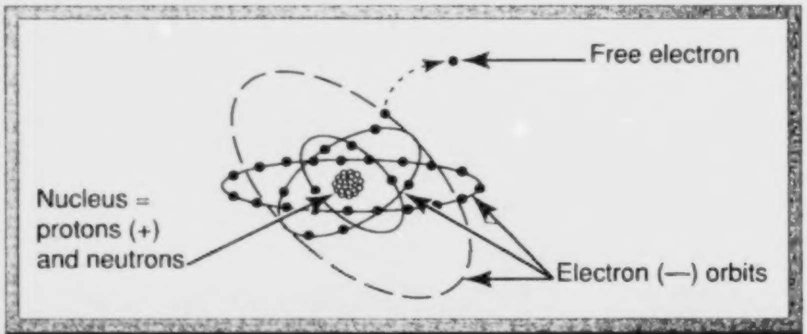

Figure 2
Atom

7. **Electricity is the flow of one electron to another.**

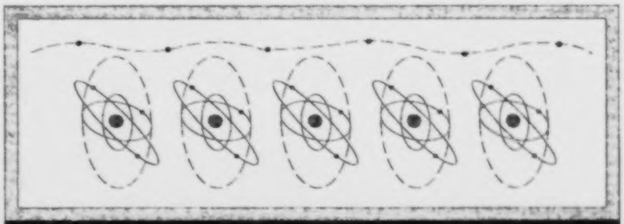

Figure 3
Electron flow

✔ **NOTE:** Bohr's Theory is based on the flow of free electrons that ultimately produces electricity.

8. **Conductors are materials through which electrons flow easily.**

   Examples: A current-carrying device such as a wire or copper bar

9. **Copper, aluminum, silver, zinc, and brass are all good conductors. Copper is the most commonly used conductor.**

10. **Insulators are materials or substances that resist electron flow.**

    Examples: Rubber, plastic, and wood

11. **By wrapping an insulating material around a conductor, the current is prohibited from passing to other conductors.**

    Example: The rubber cord that encompasses the wiring which connects electrical equipment prevents shock by preventing the body from completing a circuit to ground.

12. **Generation occurs when an outside force of power excites the electron flow and electricity is produced.**

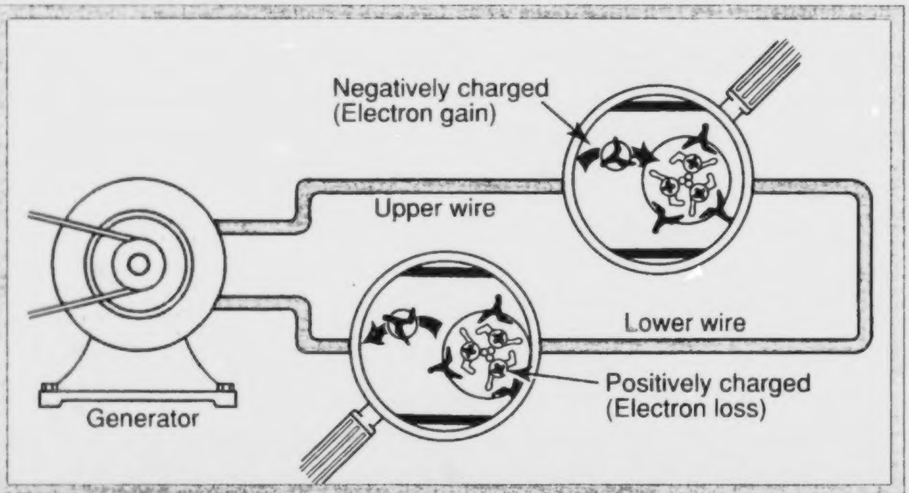

**Figure 4**
**Generation of electricity**

From publication *Understanding Electricity* © AAVIM.

KEY TERM

**Electron flow**—Electrons transferring from one atom to another

OBJECTIVE 4 **Complete statements concerning the basic sources of electrical generation.**

1. **Friction produces electricity when two materials are rubbed together.**

   ✔ **NOTE:** This type of electrical generation produces static electricity.

   Example: When you slide your feet across a nylon or wool carpet, your shoes develop a charge that is transferred to the body.

2. **Pressure produces electricity when pressure is applied to crystalline substances such as quartz or tourmaline.**

   Example: A crystal microphone or in a phono cartridge on the pickup arm of a record player

3. **Heat produces electricity when it is applied to the junction of two dissimilar metals.**

   Example: Thermocouple used in a water heater

4. **Light produces electricity when it strikes a photosensitive material.**

   Example: Solar cell used on spacecraft

5. **Chemical action produces electricity when that action takes place between two metals in a cell.**

   Example: Automobile and flashlight batteries

6. **Magnetism produces electricity when a magnet is moved past a piece of wire.**

   Example: Generator in a power plant or automobile

**OBJECTIVE 5** **Select true statements concerning magnetism.**

1. **Magnets consist of iron, cobalt, or nickel.**
2. **Each end of a magnet is referred to as a pole. One end is the north pole and the other end is the south pole.**
3. **A magnetic field occurs when two magnets are placed end to end. Even the earth has a magnetic field.**
4. **When the north pole is put to the south pole, they attract.**
5. **When the north pole and north pole are aligned, they repel.**
6. **When the south pole and south pole are aligned, they repel.**
7. **Magnetic attraction varies with pole strength and distance.**
8. **Magnetism is used in many electrical devices.**
9. **A magnet is composed of lines of power, called flux lines, around the magnetic field.**

**OBJECTIVE 6** **Complete statements concerning electromagnetism.**

1. **Electromagnetism occurs because of electrical current flow.**
2. **Electromagnets are used to generate electricity, store memory on computers, generate images on a television screen, diagnose illnesses, and in anything else that depends on electricity.**

   Examples: Magnetic Resonance Imaging (MRI) is an example of how electromagnets are used in the health field.

3. **Electromagnetism is formed when an electric current through a wire generates a magnetic field. In a wire, the magnetic field forms around the wire. By wrapping a wire around a metal object, the object will become magnetized, thus, creating an electromagnet.**

OBJECTIVE 7

**Match terms related to electrical *current* with their correct descriptions.**

1. **Direct current (DC)**—An electrical current flowing in one direction only and substantially constant in value

   Examples: Flashlights and automobile engines

2. **Alternating current (AC)**—An electrical current flowing in two directions; it flows in one direction, stops, and then flows in the opposite direction

   ✔ **NOTE:** A hertz is one complete positive or negative cycle in an alternating current circuit.

   Examples: Lightbulbs, refrigerators, and other household appliances

3. **Cycle**—Refers to alternating current and the rate that it changes from a positive to a negative pattern of movement

   ✔ **NOTE:** This is also referred to as the frequencies of reversal.

4. **Frequencies**—The rate as determined by the generating force

   ✔ **NOTE:** Radio frequency is an alternating current transmitted through the airwaves.

KEY TERM

**Current**—Electron flow through a conductor

✔ **NOTE:** Current is to electricity as flow is to water.

OBJECTIVE 8

**Select true statements concerning measuring electricity.**

1. **Ampere (amperage; amp)**—Measures the intensity of the electron flow in a circuit

   - Ampere ratings on equipment indicate the amount of current needed to operate the equipment properly.

     ✔ **NOTE:** When more current than is indicated on equipment passes through the equipment for an extended amount of time, the equipment will be damaged from overheating. This is also what causes fuses to blow and circuit breakers to trip.

   - Wall switches, circuit breakers, and fuses are all rated in amperes.

2. **Volt (voltage)**—Measures electrical pressure that is applied to force electrons through a circuit

   - For a current to flow in a conductor, a force must be applied at one end. This electron-pushing force is called the electromotive force (emf).
   - Circuits used in the operating room are supplied with ______ volts. This voltage will serve any equipment that has approximately the same voltage stamped on it.

3. **Ohm**—Measures electrical resistance

   - Resistance forces electrons from one atom to the next atom.
   - The amount of resistance is determined by:
     - — Substance that makes up the conductor
     - — Size of the conductor
     - — Length of the conductor
   - When supplying electricity to various outlets in an operating room, the more current the wires must carry and the distance it is carried, the larger the wire size should be.

4. **Watt (wattage)**—Measures electric power

   - Combining volts and amperes produces a measurement of power (watts).
   - The formula for power is: Power = Amps or Current x Volts

OBJECTIVE 9 **State Ohm's law.**

- **Ohm's law**—The current in an electric circuit equals the pressure (volts) divided by the resistance

  ✓ **NOTE:** It takes 1 volt to push 1 amp through 1 ohm of resistance.

OBJECTIVE 10 **State the formula for Ohm's law.**

- **Volts = Amps x Ohms**

OBJECTIVE 11 **List the uses of Ohm's law.**

1. **Calculating circuit resistance**
2. **Calculating circuit amperage**
3. **Calculating circuit voltage**

OBJECTIVE 12

**Match wires contained in an electrical *receptacle* with their correct descriptions.**

1. **Hot wire**—The wires that are connected to the power supply or source; usually black, red, and blue in color
2. **Neutral wire**—The wires that are connected to the neutral bar of the power supply and can sometimes serve as a ground; usually white or light gray in color
3. ***Ground* wire**—This wire is provided as a safety for the piece of equipment it operates. It is attached to the case of the unit and connected to a ground bar, water line, to earth. It can be distinguished normally as a bare copper wire or a medium green wire.

KEY TERMS

**Receptacle**—A point along an electrical circuit to which a cord plug is attached for the purpose of using the current supplied by that circuit

**Ground**—Electrical point on any good conductor that is connected to a common chassis with zero relative voltage; usually conductors are connected to the earth

OBJECTIVE 13

**Complete statements concerning wall outlets and plugs commonly used in the operating room.**

1. **Wall outlets used in operating rooms are normally 110V.**
2. **Grounded outlets are used in operating rooms to automatically ground equipment when plugged into an outlet to reduce risk of electrocution. Grounded outlets have a round receptacle for the ground prong on a plug.**

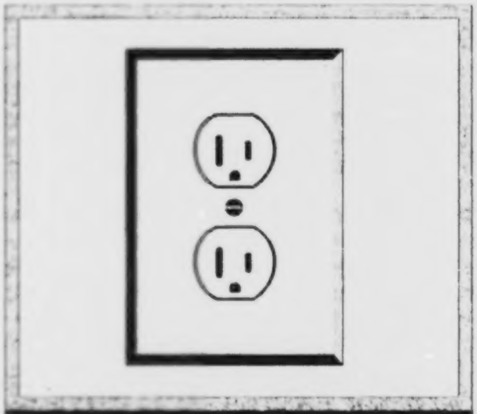

Figure 5
Grounded outlet for a three-prong plug

3. **Three-pronged plugs are primarily used in electrical equipment found in the operating room. The third prong of the plug serves as the grounded plug.**

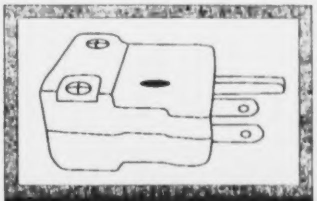

Figure 6
Three-pronged plug

**OBJECTIVE 14** **List the primary equipment used in surgery that requires electricity to function.**

1. **Electrical monitoring equipment**
2. **Electrosurgical systems (Bovie)**

   ✔ **NOTE:** For more information about electrosurgery systems, refer to Objectives 19 through 22 of this module.

3. **Endoscopes**

   ✔ **NOTE:** For more information about endoscopes, refer to *Module 3-E: Physics*, Objective 22.

4. **Lasers**

   ✔ **NOTE:** For more information about lasers, refer to *Module 3-E: Physics*, Objectives 23 and 24.

5. **Robotics**

   ✔ **NOTE:** For more information about how robotics is used in surgical technology, please refer to *Module 4-E: Robotics*.

6. **Video equipment/computers**
7. **X-ray machines**

   ✔ **NOTE:** For more information about X-ray machines, refer to *Module 3-E: Physics*, Objectives 25 through 28.

**OBJECTIVE 15** **List the major causes of electrical accidents.**

1. **Rushed or distracted personnel (carelessness)**
2. **Failure to verify that equipment was deenergized**
3. **Misuse of tools or equipment**

**OBJECTIVE 16**

**Complete statements concerning facts about electrical shock.**

1. **High *voltage* (low current) tends to knock the victim away from the *circuit*, minimizing exposure time.**
2. **High current tends to cause the body to adhere to the circuit, so that the victim cannot let go.**
    - At about 1 milliampere (0.0010 **ampere**), a single shock will be felt.
    - At about 10 milliamperes (0.010 ampere), the shock is severe enough to paralyze muscles, and a person may not be able to let go of the conductor.
    - At about 100 milliamperes (0.1 ampere), the shock is usually fatal if it lasts 1 second or more.

    ✔ **NOTE:** Human body **resistance** varies from about 500,000 ohms when dry to about 300 ohms when wet. Because of this, voltages as low as 30 volts can cause enough current to be fatal. Any circuit with a potential of at least 30 volts must be considered dangerous.

KEY TERMS

**Circuit**—A conducting path for electrons

✔ **NOTE:** An isolated circuit is designed to operate only the unit to which it is attached and has an unobstructed path to ground.

**Resistance**—Opposition to current flow through a circuit; a characteristic of electricity rated in Ohms

**OBJECTIVE 17**

**Select true statements concerning static electricity.**

1. **Static electricity is a common hazard in the operating room.**
2. **Static electricity does not cause the patient shock or burns.**
3. **Static electricity produces a spark which can ignite materials in the oxygen rich atmosphere of the operating room.**
4. **Static electricity develops from friction and accumulates on physical objects.**
5. **When two static-bearing objects come in contact, the one bearing the higher potential discharges to the one with the lower potential.**
6. **An electrostatic charge or spark between two objects can occur only when there is no pathway of conductivity between them; therefore the chief aim is dissipating the static accumulation.**
7. **A good conductive floor prevents accumulation of static electricity by providing a pathway of conductivity between all persons and equipment coming into contact with it.**

8. Safe furniture is made of electrically conductive materials or contact to the floor is made through electrically conductive leg tips, casters, or wheels.
9. Electrically conductive materials must be kept clean and free of debris such as dirt, dust, wax, blood, glass, or suture in order to retain their full conductivity.
10. Oils, waxes, and detergents reduce the conductivity of floors and should not be used in the operating room.
11. Operating room floors are cleaned with materials that do not reduce conductivity, such as iodophor or phenolic detergents/disinfectants.

**OBJECTIVE 18** Complete statements concerning grounding operating room electrical equipment.

1. All electrical equipment, including heart monitors, defibrillators, X-ray machines, electrosurgical units, and electrical saws and drills, must be grounded to prevent the leakage of stray current.
2. When an instrument or piece of equipment is properly grounded, leakage current returns to the earth, via the ground, causing no damage.
3. If the ground path is interrupted by broken or frayed cords, plugs, or defective equipment, leakage current will seek another path to ground, and this alternate path may be through operating room personnel.

**OBJECTIVE 19** Identify the components of an electrosurgery system.

1. Generator

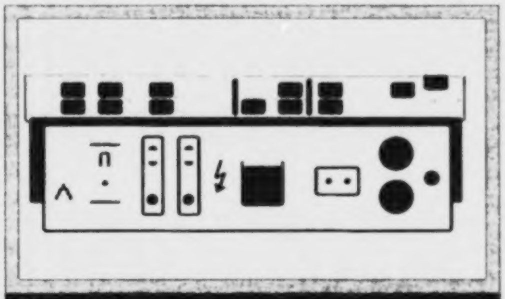

Figure 7
Generator

2. **Active electrode**

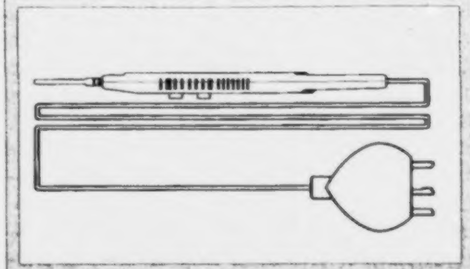

Figure 8
Active electrode

3. **Dispersive (inactive) electrode**

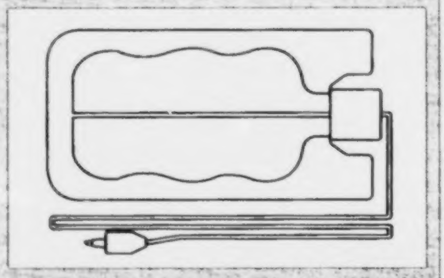

Figure 9
Dispersive electrode

OBJECTIVE 20

**Match *electrosurgery* components to their descriptions.**

1. **Generator**—Machine that produces the power for the active electrode to create a ***coagulating*** or ***cutting current***
2. **Active electrode**—Sterile handpiece that directs the flow of current from the generator to the tissues at the operative site (generator to tissues)
3. **Dispersive (inactive) electrode**—Site that disperses the current released through the active electrode and provides a return from the tissues at the operative site back to the generator (tissues to generator)

KEY TERMS

**Electrosurgery**—The use of high-frequency electrical current for controlled cutting, coagulation, dehydration, or dessication of tissue

**Coagulating current**—Sears the ends of vessels to control bleeding

**Cutting current**—Incises tissue

**Objective 21**

**Distinguish between types of electrosurgery units.**

1. **Bipolar unit**

   - This unit allows the current to flow only between the tips of the active electrode and then returns to the generator.
   - Current does not disperse through the patient, thus a grounding pad is **not** necessary.

2. **Monopolar unit**

   - Current flows from generator to active electrode, through the patient, to an inactive dispersive electrode, and then back to generator.
   - Because the generator current is dispersed from the active electrode, it seeks completion of the electrical circuit to ground or neutralization through the patient's body.
   - An inactive dispersive electrode (a patient grounding pad/plate placed in direct contact with the skin) **must** be used to ground the patient.

   ⚠ **CAUTION:** The dispersive grounding pad/plate must be properly placed and connected to avoid electrical burns to the patient.

**Objective 22**

**Complete safeguards for using electrosurgery units.**

1. **Place dispersive electrode**

   - As close as possible to the operative site,
   - To cover as large a surface area as possible, and
   - On a clean, hair-free, scar-free area.

2. **Do not place dispersive electrode on skin over a metal implant.**
3. **Make sure that the dispersive electrode is clean, free of bent edges, and adheres uniformly to skin.**
4. **Make sure that the connection between the dispersive electrode and the generator is secure.**
5. **Ensure that the metal connection between pad or plate and conductor cord does not touch the patient.**

   ✔ **NOTE:** An electrical burn to the patient's skin is the greatest hazard of electrosurgery.

6. **Do not use flammable anesthetics with electrosurgery.**
7. **Do not use electrosurgery on the mouth, around the head, or in the pleural cavity when high concentrations of oxygen or nitrous oxide are used.**

8. **Place ECG electrodes as far away from the operative site as possible to avoid diversion to an alternate ground site.**

9. **Know that connecting a bipolar active electrode to a monopolar receptacle may activate current and cause a short circuit.**

10. **Know that explosion can occur if electrical sparks ignite flammable gases or solutions.**

    ✔ **NOTE:** Although fire hazards have been greatly reduced over the years, faulty wiring, poorly maintained equipment, and lack of appropriate safety measures are still causes for concern.

11. **Use moist sponges to prevent fire.**

12. **Investigate a repeated request to increase the "power" or "current." The dispersive electrode or connecting cord may be detached.**

13. **Know that contact with the 110/120 volt 60 Hz input power can cause electric shock or even death by electrocution.**

    ✔ **NOTE:** Electrocution or shock can occur because of an internal fault in the generator, but is more likely to occur in ground-referenced electrosurgery, because the patient is directly connected to ground by the dispersive pad.

14. **Follow all manufacturer's guidelines and cautions on operation and use of the unit.**

15. **Keep the electric cautery tip in a holster when it is not being used.**

16. **Be alert: Know that most incidents involving electrosurgical units are caused by personal error.**

17. **To minimize noxious odors and/or potential toxic effects of electrosurgical smoke, wear a high-filtration surgical mask during procedures that generate laser plume, surgical smoke, or aerosol.**

    ✔ **NOTE:** Smoke created by electrosurgery is just as dangerous as the smoke created by the use of lasers. It should be evacuated to protect surgical staff and patients from its potentially harmful effects.

18. **Evacuate laser plume, electrosurgery smoke, and noxious fumes through a filter device and smoke evacuation system, so that hazardous particles do not become airborne and deposit in the respiratory tracts of the surgical team.**

19. **Avoid using wall vacuum lines for plume capture, because of possible future deterioration of vacuum systems and low-volume situations preventing full capture of the plume at the surgical site.**

20. **Place the evacuation system suction tubing as close to the source of smoke as possible (some recommend within 2 cm), in order to maximize smoke capture and enhance visibility at the surgical site.**

**OBJECTIVE 23**

## Assignment Sheet 1—Evaluate Surgical Applications of Electricity

Name ______________________ Date ____________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ____ |
| • Questions were answered honestly | ____ |
| • Correct grammar, spelling, and punctuation were used | ____ |
| **Overall rating** | ____ |

Evaluator's comments ______________________

**DIRECTIONS** Respond to each question or situation, then have your instructor evaluate.

1. Workplace safety involves minimizing static electricity, checking operating room electrical equipment for grounding and managing electrosurgical units properly. Drawing on what you learned in *Module 2-B: Workplace Safety* and this module, explain what you would do in the following situation. A unipolar electrocautery unit is being used, in which current flows from a generator to an electrode, through the patient, back to a dispersive electrode and back to the generator to complete the loop. Excess fluids have made the floor slick and the conductor cord has come in contact with the dispersive grounding pad.

   What are the potential hazards?

2. You notice a frayed cord on an X-ray machine. What steps should you take to correct this problem?

3. A patient is being prepped for electrosurgery on his upper body. You notice that he is wearing a necklace. What are the potential hazards of this situation? What steps should you take to alleviate the hazardous situation?

4. You notice a coworker unplugging a piece of equipment in the operating room by pulling on the cord. What is the correct way to unplug equipment?

**OBJECTIVE 24**

# Job Sheet 1—Position Grounding Pad and Connect Electrosurgical Unit

Name ______________________ Attempt number ______________
Date ______________________ Overall rating ______________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Assembled necessary supplies and equipment | ______ |
| • Followed directions | ______ |
| • Performed each step in appropriate sequence | ______ |
| • Connections are secure | ______ |
| • Grounding pad is correctly positioned | ______ |
| • Minimum settings are used | ______ |
| • ESU operates as designed | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

______________________________________________

______________________________________________

---

**INSTRUCTIONS**

When you are ready to perform this task, ask your instructor to observe the procedure and rate your performance using the evaluation criteria.

**EQUIPMENT AND MATERIALS**

- Electrosurgical power unit
- Pregelled grounding pad and cable
- Electrosurgical pencil or bipolar forcep

**PROCEDURE**

☐ 1. If hand-control pencil is used,

  ☐ a. Visually inspect all cords and plugs. Report any damage to supervisor, and do not use.

  ☐ b. Check to make sure power switch on unit is in "off" position.

  ☐ c. Connect power unit cord to grounded three-prong wall outlet.

  ☐ d. Position grounding pad—Open package, remove paper from pregelled pad, and apply adhesive side of pad to selected site.

  ☐ e. Connect grounding pad to power unit in receptacle marked "patient."

- ☐ f. Plug distal end of electrode to power unit in receptacle marked "hand switch."
- ☐ g. Turn coagulating and cutting levels to minimum settings.
- ☐ h. Turn power switch on.

☐ 2. If foot switch is used,

- ☐ a. Visually inspect all cords and plugs. Report any damage to supervisor, and do not use.
- ☐ b. Check power switch on unit to make sure it is "off."
- ☐ c. Connect plug of foot switch to active receptacle of unit if necessary.
- ☐ d. Connect grounding pad to power unit.
- ☐ e. Connect active electrode.
- ☐ f. Place foot switch on floor for convenient use by surgeon.
- ☐ g. Turn cutting and coagulating levels to minimum settings.
- ☐ h. Turn power switch on.

Evaluator's Comments: ________________________________________

________________________________________________________________

________________________________________________________________

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 3-E: Applied Physics

# Introduction to Surgical Technology
# Section E: Biomedical Science
# Module 3-E: Applied Physics

## Module Contents

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# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 3-E: Applied Physics

**PREREQUISITES:** None

### Learning Activities Sheet

Student name ______________________________

**DIRECTIONS** Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor

☐ 2. **Stop** Have your instructor evaluate your performance.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Study** Information Sheet, Objectives 1 through 7.

☐ 5. **Read** Student Supplement 1, "Motion and the Human Body."

☐ 6. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 7. **Do** Job Sheet 1, "Test Atmospheric Pressure."

☐ 8. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 9. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat step 7.

☐ 9. **Do** Assignment Sheet 1, "Apply Motion and Leverage to the Workplace."

☐ 10. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 11. If the evaluation is not satisfactory, return to step 9.

☐ 11. **Research** Online resources to learn more about motion. Your instructor will add several recommended URLs below. Visit at least two.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 12. **Read** Student Supplement 2, "Understanding Matter and Energy."

☐ 13. **Study** Information Sheet, Objectives 8 through 11.

☐ 14. **Do** Assignment Sheet 2, "Evaluate States of Matter."

☐ 15. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 16. If the evaluation is not satisfactory, return to step 14.

☐ 16. **Read** Student Supplement 3, "Waves," and Student Supplement 4, "Sound Waves."

☐ 17. **Study** Information Sheet, Objectives 12 through 14.

☐ 18. **Read** Student Supplement 5, "The Electromagnetic Spectrum."

☐ 19. **Study** Information Sheet, Objectives 15 and 16.

☐ 20. **Observe** Demonstration of procedures to be used in completing Job Sheet 2.

☐ 21. **Do** Job Sheet 2, "Create Waveform Polarization."

☐ 22. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 23. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 2 and repeat step 21.

☐ 23. **Do** Assignment Sheet 3, "Apply Electromagnetic Waveforms to Medicine."

☐ 24. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 25. If the evaluation is not satisfactory, return to step 23.

☐ 25. **Study** Information Sheet, Objectives 17 through 24.

☐ 26. **Read** Student Supplement 6, "Electricity and Surgery."

☐ 27. **Do** Assignment Sheet 4, "Research Lasers."

☐ 28. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 29. If the evaluation is not satisfactory, return to step 27.

☐ 29. **Study** Information Sheet, Objectives 25 through 28.

☐ 30. **Do** Assignment Sheet 5, "Visit a Hospital to View Radiation from Preparation to Disposal."

☐ 31. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 32. If the evaluation is not satisfactory, return to step 30.

☐ 32. **Do** Assignment Sheet 6, "Research the Implications of Using Nuclear Medicine."

☐ 33. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 34. If the evaluation is not satisfactory, return to step 32.

☐ 34. **Research** Online resources to learn more about electromagnetics and nuclear medicine. Your instructor will add several recommended URLs below. Visit at least two.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 35. **Take** Written Test provided by your instructor.

☐ 36. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 37. If the evaluation is not satisfactory, repeat steps 4, 13, 17, 19, 25, and 29.

☐ 37. **Check** With your instructor for any additional assignments to be completed.

☐ 38. **Do** Additional assignments your instructor lists below.

______________________________

______________________________

______________________________

☐ 39. **Take** Module Review provided by your instructor.

☐ 40. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 41. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the Written Test, assignment sheets, job sheets, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions

# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 3-E: Applied Physics

## Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to utilize physics in performing tasks as a surgical technologist. You should be able to demonstrate comprehension and application of appropriate principles of physics by completing the assignment sheets and job sheets and scoring a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Distinguish among gravitational, magnetic, and electrical forces.
2. Complete statements concerning pressure.
3. Match Newton's three laws of motion to their correct descriptions.
4. Explain why blood separates in a centrifuge.
5. Select true statements concerning types of simple machines.
6. Explain center of gravity and its effect on posture and occupational safety.
7. Complete statements concerning the modes of motion.
8. Select true statements concerning the composition of matter.
9. Select true statements concerning matter's three changes of state.
10. Complete statements concerning heat transfer.
11. Explain cryosurgery and its advantages.
12. Complete statements concerning waveforms.
13. Describe how ultrasound scans work.
14. Explain how doppler ultrasounds work.
15. Complete statements concerning the dual nature of light.
16. Match the electromagnetic spectrum types to their correct uses.
17. Complete statements concerning magnetism characteristics.
18. Distinguish between static and dynamic electricity.
19. Complete statements concerning electricity and electric current.
20. List the physical and biological effects of electric current that prove helpful in medicine.
21. Complete statements concerning fiber optics.
22. Describe how optical fiber is used in endoscopic surgeries.

23. Complete statements concerning the use of lasers in surgery.
24. Match laser types to their correct descriptions.
25. Select true statements concerning the use of nuclear medicine in surgery.
26. Complete statements concerning CT scans.
27. Explain the importance of setting irradiation and measuring dosage.
28. List methods for protecting against occupational irradiation.
29. Apply motion and leverage to the workplace. (Assignment Sheet 1)
30. Evaluate states of matter. (Assignment Sheet 2)
31. Apply electromagnetic waveforms to medicine. (Assignment Sheet 3)
32. Research lasers. (Assignment Sheet 4)
33. Visit a hospital to view radiation from preparation to disposal. (Assignment Sheet 5)
34. Recognize the implications of using nuclear medicine. (Assignment Sheet 6)
35. Test atmospheric pressure. (Job Sheet 1)
36. Create waveform polarization. (Job Sheet 2)

## Information Sheet

**OBJECTIVE 1** **Distinguish among gravitational, magnetic, and electrical *forces*.**

✔ **NOTE:** A force may not necessarily be visible, but its impact should be observable. For instance, gravitational, magnetic or electrical forces by their very nature attract or repel and this is indicated in the effects each produces.

KEY TERM

**Force**—A push or pull on an object, resulting from contact or interaction with another object; this contact can be normal contact or a special kind of contact based on friction or tension

1. **Gravitational force**

   ✔ **NOTE:** Our focus is on principles of gravity that influence motion.

   - Generically thought of as a "pull," thus, the apple falls!
   - Used in infusions, transfusions, irrigations and drainage
   - Used to relocate organs out of the way by turning or tipping patient on surgical bed

2. **Magnetic force**

   ✔ **NOTE:** In this module, magnetic force is defined not just by its direction and the strength of pull or push, but also by the type of material it is attracting or repelling.

   - Can pull or push, since there is polarity of north and south. This is a classic case of "opposites attract," since north repels north, but attracts south and vice versa.
   - Used to remove metal objects from the human body (shrapnel, metal splinters, etc.)
   - Used to guide catheters through internal body passages
   - Used in probes to detect internal anomalies

3. **Electrical force**

   - Uses parts of each atom that attract or repel to create movement
   - Quantity of electrical force depends on sheer output of power. Electrical power can be electrostatic, having no movement, or power can be electrodynamic, where it does have movement. Electrical power sources include radiant, thermal, chemical, and mechanical energy sources.
   - Electrostatic charges collect through surface friction where there are potential differences and grounding is not available.

- Electrodynamics occur when a steady source of electrons move through a form of conductor. The conductor can be metal, vacuum, gas, or electrolyte.
- Application of electrical force can be applied to a patient's heart if it has stopped (defibrillator) or can be applied in low-current flows to portions of the human body for heat therapy, nervous and muscular disorders and for diagnostics.

OBJECTIVE 2

**Complete statements concerning pressure.**

✔ **NOTE:** Pressure and force are often thought to be identical or treated the same. There are distinct differences.

1. **Pressure**

   - Results from a given amount of force being exerted in a specific area
   - Generally measured in PSI (pounds per square inch) and GSC (grams per square centimeter)
   - Points of greater pressure always flow to points of lesser pressure.
   - A point of pressure in liquids or gases results in an increase in pressure on the advancing side and a decrease on the retreating side similar to watching the ripples after a stone is dropped in water; a wave.
   - The greater the pressure, the sharper the waves and the longer the duration before the wave propagation drops back to equilibrium.

     ✔ **NOTE:** Equilibrium, for this module, is "normal atmospheric pressure."

2. **Pressure types**

   - Normal atmospheric pressure
     - — The standard pressure of the atmosphere on earth at sea level is 76.0 cm or 760.0 mm Hg. Blood pressure is also measured in these terms.
     - — Normal pressure also supports a column of water approximately 34 ft. high. Cerebrospinal fluids are measured in these terms.
   - Positive pressure
     - — Any rise above normal atmospheric pressure is positive pressure.
     - — Hyperbaric chambers for oxygen therapy and autoclaves, which use steam pressure for sterilization, are examples of equipment using positive pressure.
   - Negative pressure
     - — Any drop below normal atmospheric pressure is negative pressure.
     - — A drop below normal creates a vacuum, and thereby suction.

— Most medical equipment is geared towards negative pressure. Siphon-suction, gravity-suction, underwater drainage, aspirators, ventilators (iron lung), and even beds that customize pressure to prevent bedsores are all examples of equipment that use negative pressure.

✔ **NOTE:** Respirators use both negative and positive pressure to artificially assist breathing.

3. **Examples of pressure in the human body**

- The flow of gas through body airways
- The flow of a liquid (blood) through the vascular system

**OBJECTIVE 3** **Match Newton's three laws of motions to their correct descriptions.**

✔ **NOTE:** Force and pressure affect motion. Scientist Isaac Newton identified three laws of motion. Each has a direct impact on the movement of patients and equipment in the surgical setting. In addition, motion can have a dramatic effect on human tissues and structures. Newton's basic laws of motion are listed in sequence.

1. **First Law—Rest vs. Motion (Inertia)**

- If an object is at rest, it remains so; if an object is in motion, it stays in motion at the same speed and in the same direction unless changed by some balanced external force.
- Friction opposes movement. It is a resistive force, generally of a surface against an object. If the object is moving, friction works to slow or stop the motion. If the object is not moving, friction works against any movement. If no friction exists, the object will continue moving, just as a ball might in space, if it is flung from a space station. Or, compare minimal friction with significant friction. The same patient bed on casters can be sent flying down a tiled hallway, but when pushed with the same force, move a much shorter distance down a carpeted hallway. Should a patient being wheeled down the hall be on a slick OR table with little friction, turning a corner quickly can have disastrous effect. Were the same patient transferred to a patient bed, that same corner can be turned at the same speed with much less impact.

Example: Surgical instruments on a tray remain where they are as long as nothing moves them. As the tray is moved, the instruments at rest on it assume the velocity of the tray. Should the carrier of the tray come to a sudden stop, the instruments on the tray continue at velocity, sliding forward, unless there is enough friction, such as a rubber mat, to halt it.

2. **Second Law—Speed (Acceleration and Deceleration)**

- If an imbalanced external force is applied to a moving object, the object will accelerate in the direction of the imbalance. How powerful that acceleration is depends on the speed and the mass of the external force. This links acceleration and direction with momentum.

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- Acceleration is inversely proportional to mass. Moving an object with twice the mass will take double the force, i.e., a doubling of mass with a constant acceleration will cut in half the force of the acceleration. If the mass is cut in half, then the acceleration is doubled.

- For the purpose of this module, Newton's second law will be paired with the principle of the conservation of energy. Energy cannot be created or destroyed, but it can be absorbed, thus altering the form or shape of a structure. Since energy is defined as force times distance, the damage done as energy is absorbed depends on the distance traveled.

  Example: Persons in a motor vehicle assume the velocity of the vehicle. It takes twice as much energy to move a car that has passengers weighing a total of 500 pounds than it does with passengers with a total of 250 pounds. Should this vehicle collide with another vehicle that is moving in parallel, the damage to the vehicle and its occupants is less lethal than if immediately stopped by a stationary object or a head-on collision.

  - Mass and substance of objects at impact
  - Velocity of objects upon impact
  - Direction of acceleration of objects upon impact
  - Duration of impact
  - Time for which the object and human body moved
  - Displacement of the object and human body

**3. Third Law—Action and Reaction**

- For every action of force, there is an equal (in mass) and opposite (in direction) reaction of force. This is commonly called a force pair.

  Example: A patient has simple closed fractures to both the radius and ulna bones which require manual realignment prior to casting. To accomplish this, two people must work together, stretching muscle and bone equally hard in opposite directions, creating a force pair.

OBJECTIVE 4 **Explain why blood separates in a centrifuge.**

**1. Centripetal and centrifugal force**

- When an object moves in a circular path at a constant speed, its force keeps changing, since the direction of the object continues to change.

- This requires an unbalanced force to continue acting on the object and there is an outward pull to the object.

- The acting inward (centripetal) force is equivalent to the reactive outward (centrifugal) force.

- The faster the object circles, the stronger the reactive force outward.

2. **Centrifuge**

✔ **NOTE:** Centrifugal force is used in the laboratory centrifuge for separating blood. This is termed a hematocrit.

- Those molecules that are least dense form a layer at the top or center of the twirled test tube.
- The heavier molecules gravitate to the outer region or bottom of the test tube.

3. **Hematocrit**

- Blood contains particles that are different in weight and size.
- Blood cells are larger than the plasma or water molecules carried in the blood.
- Blood cells
    - Approximately 45% of blood is cellular, a mix of platelets, red blood cells and white blood cells.
    - White blood cells are less substantial than red blood cells.
- Plasma
    - On average, 55% of blood is plasma
    - Most of the plasma is actually water
    - Only roughly 10% are nutrients, chemicals, proteins and hormones.
    - Water molecules are fairly small and protein molecules are heavy, particularly compared to blood cells
- Protein, nutrients, chemicals, hormones, leukocytes and even DNA can be obtained, precipitated, separated, washed and/or lysed.

OBJECTIVE 5 **Select true statements concerning types of simple machines.**

✔ **NOTE:** Understanding the principles of force and the use of simple machines provides the means to perform tasks effectively and efficiently.

1. **Levers**

- Levers are used to lift, pull, or push objects; force is applied to a fairly rigid structure that moves around a fixed pivot point.
- Levers always consist of the following three components:
    - Fulcrum—Fixed pivot point ▲
    - Load or resistance—Opposition to force ⇩

  - Effort—Exertion of force ⇧

- Classes of levers

  - Class I—Fulcrum is placed between effort and resistance

    Examples: Surgical scissors, retractors, old-style balance-beam, "justice" scale, crowbar or teeter totter

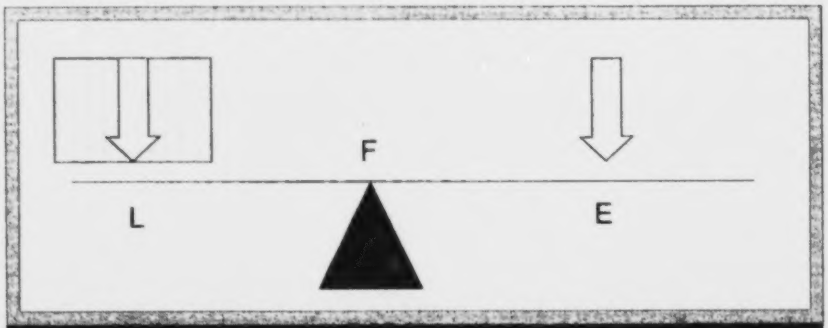

**Figure 1**
Class I lever diagram

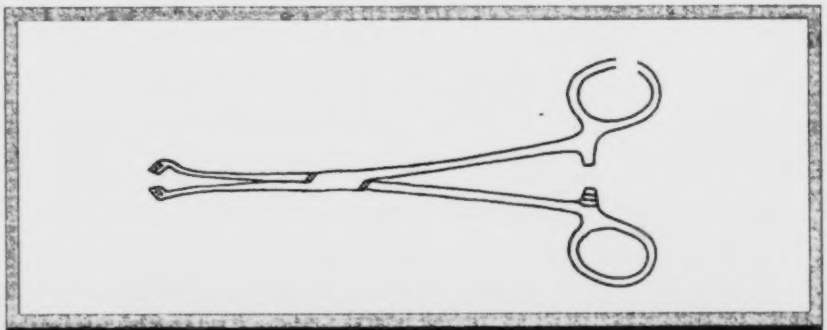

**Figure 2**
Class I surgical instruments Babcock forceps and Mayo scissors

— Class II—Resistance is between the fulcrum and effort.

Examples: Moving dolly, bottle opener, wheelbarrow, turning a mattress, and rising on the ball of your foot

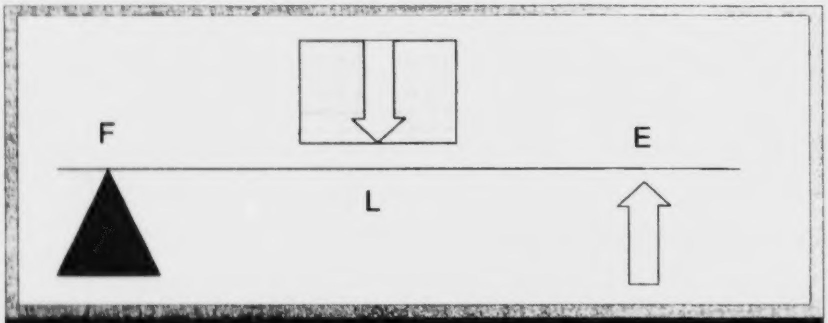

**Figure 3**
Class II lever diagram

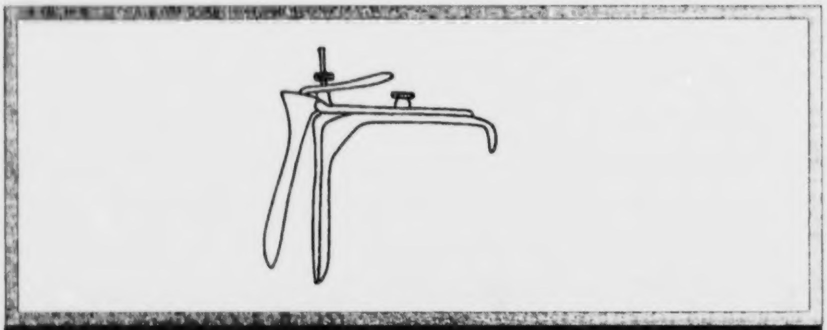

**Figure 4**
Class II surgical instruments Graves vaginal speculum

— Class III—Effort is between the fulcrum and resistance.

Example: Thumb forceps

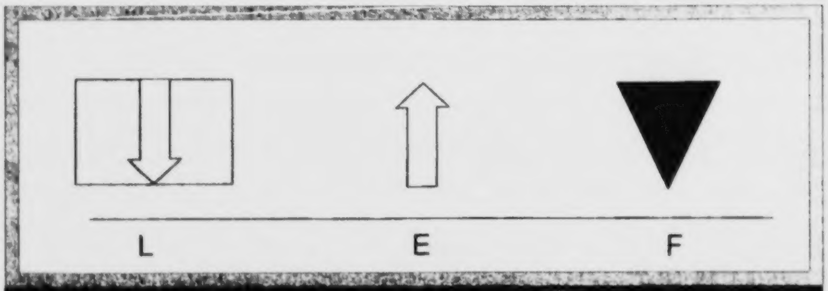

**Figure 5**
Class III lever diagram

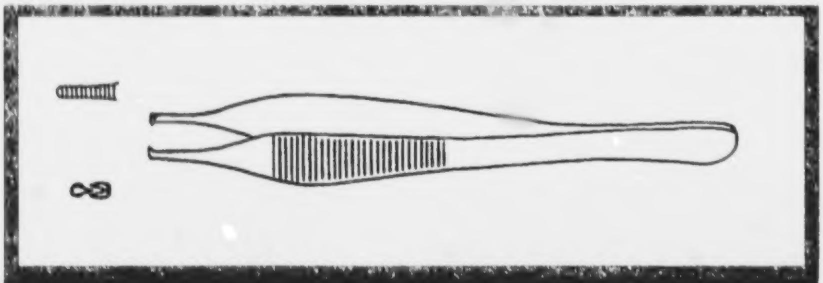

Figure 6
Class III surgical Instruments Adson forceps

2. **Inclined plane, wedge, and screw**

   - An inclined plane is at an angle between a horizontal and vertical difference, usually to overcome a step or vertical difference.

     Example of inclined plane: Ramps for moving patients

   - A wedge is a modified inclined plane.

     Examples of a wedge: Surgical tools and knives with beveled edges for cutting; sharps with a longer and shorter side to the tip

   - The screw is a modified inclined plane.

     Example of a screw: Crank that raises or lowers a bed

3. **Wheel and axle**

   - The wheel and axle consist of a wheel with a hole in the center, into which an axle is threaded.
   - Sometimes the wheel turns on the axle; sometimes the axle moves the wheel.
   - Uses for a wheel and axle include doorknobs, keys, screwdrivers, roller skates, casters on carts and beds.

4. **Pulley, fixed or moveable**

   - Pulleys employ a wheel with a grooved rim into which a chain or rope fits.
   - Pulleys can lift objects or move them sideways.
   - Pulleys are used in therapy and also in balanced traction.

**OBJECTIVE 6** **Explain the center of gravity and its effect on posture and approach to work.**

✔ **NOTE:** Gravitational force affects how we stand, walk, and work. With proper posture and skeletal alignment, muscles function optimally. With poor posture, muscles must work hard to support the body against gravitational force. They become increasingly tense on the side that is working and slack in the opposing muscles. This imbalance also eventually affects skeletal joints, causing deterioration.

1. **Center of gravity**
   - Gravity acts on all parts of an object.
   - An object's center of gravity relates to the distribution of its mass.
   - An object's center of gravity is the point where the entire mass of the object is concentrated.
   - In humans, center of gravity shifts as body positions change.
2. **Posture and approach to work**
   - **Standing straight**—Center of gravity is in the pelvic cavity.
   - **Walking**—Center of gravity should be above the foot on the ground with upright body posture.
   - **Leaning forward**—If one foot is forward, center of gravity should be at the hip above the forward foot.
   - **Lifting**—Enlarge the base of center of gravity by spreading the feet to shoulder width, squat with the knees and push upward through the pelvis, keeping the object you are lifting as close to the pelvis as possible.
   - **Reaching**—Place one foot forward under the pelvis to maintain stability. Better posture dictates crouching and pulling the object closer, than rising.
   - **Working below the waist**—Kneel or spread the feet, place one foot forward, keep both knees bent.
   - **Working above the shoulders**—Best not done. Find a means to raise the body to a comfortable working height or to lower the object.

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**OBJECTIVE 7**

**Complete statements concerning the three modes of *motion*.**

✓ **NOTE:** Each independent mode of motion is considered a "degree of freedom" or DOF.

1. ***Translational* and *angular* movement**

   - X-axis—Movement from left to right (yaw)
   - Y-axis—Movement from top to bottom (pitch)
   - Z-axis—Movement inward or outward

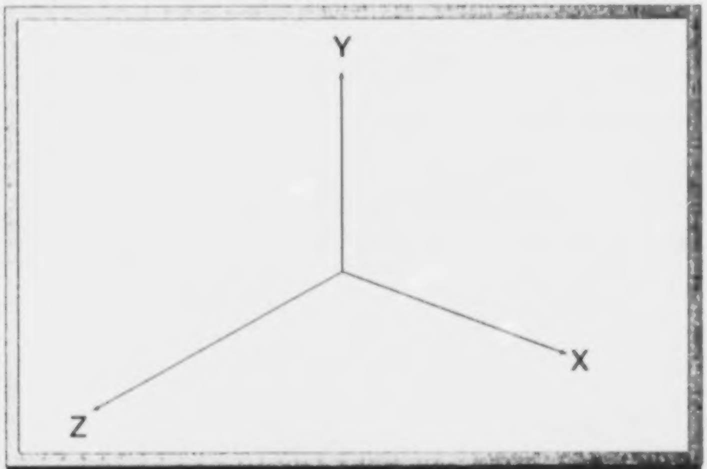

**Figure 7**
Axes of movement

2. **Rotational movement**

   - Rotation can occur on the X-, Y- or Z-axes (roll).
   - Rotation is a turning of x degrees.

     Examples: 90°, 180° or 360° turns

3. **Vibrational movement**

   - Vibration is an oscillation.
   - Vibration can occur as a simple motion on the X-, Y- or Z-axes.
   - Vibration can occur as a compound motion on more than one axis (up/down and forward/backward or right/left).

KEY TERMS

**Motion**—Can occur on the molecular, muscular, **skeletal** or whole body level

**Skeletal motion**—Is complex or rotational in nature

**Translational**—A rigid movement on a single plane or axis

**Angular**—Combines two of the translational axes

4. **Application**

   - Muscles frequently function in complex fashion, where not all force is going in a single direction, but most often in multiple directions at once (contracting upward and contracting downward to create the focus of the energy at the midline).
   - Physics have proven that muscles function best and are at their optimal strength when at half of their total possible tension, sort of a midline.
   - It has also been proven that the right shape and design of a material can withstand larger forces than one that is a less efficient shape. The large bones of the body are tubular and filled with a softer material. This allows for more weight-bearing and stress prior to fracture or breakage.

OBJECTIVE 8

**Select true statements concerning the composition of matter.**

1. **Matter**

   - Matter is any object or mass that exists in time and space.
   - Matter is composed of a collection of atoms.

2. **Atoms**

   - Atoms consist of closely bound groups of molecules.
   - Atoms of living matter are most often composites.
   - There are three basic building blocks of the molecule—**electron**, **proton**, and **neutron**.
   - Normally, there are an equal number of protons and neutrons in the atom so that the energy is balanced.
   - Neutrons clump with protons to form a nucleus, which is net positive.
   - Electrons revolve around the nucleus and don't have as much mass.

### 3. Molecules

- Molecules are groups of atoms held together in specific patterns and shapes.
- All matter is a composite of molecules, which are comprised of atoms.
- Molecules are constantly moving and can create additional force on each other when they collide.
- Molecular interaction is different for each state: solid, liquid, or gas.
- The molecular structures of atoms influence how electrons are distributed spatially and energetically.

### 4. Elements and compounds

- Elements consist of only one kind of atom type.
- Compounds consist of a combination of atoms and contain two or more elements.
- Elements are listed in the periodic table.
- The properties that elements and compounds possess are both physical and chemical, including:
  - Conductivity (of electricity and heat)
  - Reactivity (chemical)
  - Color (the electromagnetic spectrum)

### 5. Application

- The composition of atoms and the interaction of molecules is the foundation for identifying matter.
- It is also key in understanding electricity, magnetism, light, and sound.
- Medical technology depends on being able to channel this understanding and forge useful diagnostic and surgical tools.
- Ultrasound, spectroscopy, and tomography are only a few diagnostics tools which are based on the molecular structure of matter.

KEY TERMS

**Electron**—Have a "negative charge" and repulse

**Proton**—Have a "positive charge" and attract

**Neutron**—Are inactive and considered neutral

**OBJECTIVE 9** **Select true statements concerning matter's three changes of state.**

1. **Primary states of matter**

   - Solid
     - The molecules are strongly attracted to each other and are very close together, often moving through oscillation.
     - Solids can offer resistance to force and to a change in shape.
   - Liquid
     - The molecules are moderately attracted to one another and are further apart, moving freely.
     - Liquids change their shape based on pressure or tension.
   - Gas
     - The molecules are only weakly attracted to one another, and in some cases, hardly at all. They are dispersed and quite far apart with very active motion.
     - Only pressure will modify the shape of a gas in proportion to its density.

2. **Changes in state**

   - Changes in state are generally accompanied by a change in temperature and a change in pressure.
   - The thermometer and the pressure gauge are used for measuring some of these changes.

3. **Compound states of matter**

   - Solutions
     - Solutions are a mixture of particles that dissolve in a solvent or dissolving medium.
     - Solutions can be concentrated, where the majority of the solution is the element being dissolved.
     - Solutions can also be very dilute, where most of the solution is the dissolving medium and very little of the dissolved particles.
     - Solutions are expressed in percentages. For example, 7:100 (7% parts of the particles are in each 100 parts of the solution).
     - True solutions are generally clear.
     - The particles do not settle in the medium. The mixture is homogenous throughout.

       Example: Saline solution (salt in water)

- Suspensions
  - Suspensions are a mixture of particles that do not dissolve suspended in a medium.
  - In suspensions, the elements settle to the bottom of the container and must be shaken well prior to usage.

    Example: Milk of magnesia
- Colloidal dispersions
  - Colloidal dispersions are a mixture of particles where some particles dissolve and others do not dissolve in a medium.
  - The suspending medium can be solid or liquid.

    Examples: Cornstarch cooked in liquid or on a solid or foam; a gas in a liquid

4. **Other molecular phenomena**
   - Diffusion
   - Osmosis
   - Dialysis
   - Viscosity
   - Cohesion
   - Adhesion
   - Absorption and adsorption
   - Tension—Surface or interfacial
   - Elasticity and stressors

OBJECTIVE 10

**Complete statements concerning *heat transfer*.**

KEY TERMS

**Heat transfer**—Heat energy, whether produced or lost, is a natural by-product and frequent cause of a change of state. With a temperature difference between objects, heat will flow to the cooler object until an equilibrium is reached.

1. **Conduction**—The passive transfer of heat as it passes through a substance. All substances conduct heat in some fashion, though metals are certainly the best conductors.

2. **Convection**—The movement of heat from a solid to liquids such as water or gases such as air
3. **Radiation**—The movement of heat energy. There are a number of variables that determine whether the transfer of energy is absorbed into or adsorbed away from an object.
4. **Biological heat transfer**

✔ **NOTE:** The hypothalamus strives to regulate body temperatures, keeping them at a constant set point. This varies, but only by a few degrees. In normal situations, body regulators ensure heat loss and gain are equal.

- Heat gain
  - Heat is gained through external factors, such as passive heat gain from a warm environment, such as radiation from the sun or humidity in the air.
  - Heat is also gained through internal factors, such as food consumed, fat stores and increased metabolic rates or exercise.
  - Body response to **hyperthermia**
    - Rise in blood pressure
    - Hallucinations
    - Loss of bodily fluids
    - Death of cells
- Heat loss
  - Heat is lost through external factors, such as passive heat loss from a cold environment, such as wind or humidity in the air. Heat loss through immersion is the most rapid and dangerous.
  - Heat is also lost through internal factors, such as heat radiated from the skin, air from the lungs and through perspiration.
  - Body response to **hypothermia**
    - Fall in blood pressure
    - Rising levels of carbon dioxide and respiratory constriction
    - Drop in urinary and intestinal production
    - Diminished activity in the brain and nervous system
    - Metabolic acidosis

KEY TERMS

**Hyperthermia**—Heat gain is greater than heat loss.

**Hypothermia**—Heat loss is greater than heat gain.

### 5. Application

- Humans require an internal body temperature within a very narrow window. Damage to the skin, muscles or organs can result through exposure to variations outside of that window.
- This requires a balance between heat loss and gain, which is managed automatically. Changes in the capillaries bring more or less blood to the skin.
- Heat can heal.
  - Intentional heating or heat transfer can heal.
  - Heat can stabilize a patient.
  - Therapeutic heat allows more blood to flow and muscles to loosen.
- Heat can also destroy.
  - It can be an undesired effect of irradiation or intentional destruction (ablation) of abnormal cells and unwanted tissue.
  - Dry heat and steam heat are used in sterilizers and autoclaves to destroy bacteria.
  - Focused heat, such as laser surgery, can destroy abnormal tissues or actually vaporize tissue (tissue ablation).
  - Localized hyperthermia can be used to heat tissue or tumors during cancer therapy to destroy cancerous cells. Tumors have restricted blood supply and are more heat sensitive.
  - Heat through ultrasound, laser, or radio frequency can cauterize, destroy, alter or remove tissue.

OBJECTIVE 11

**Explain cryosurgery and its advantages.**

### 1. Cryosurgery

- Cryosurgery involves treating injuries and even diseases by applying cold to tissues; similar to that of heat application.
- Cryosurgery involves freezing the water in tissue with temperatures lower than –20º C.
- Destruction of tissue occurs when it is encased in a frozen ice ball. The idea is to minimize damage, leaving the surrounding tissue intact.
- Freezing occurs at the molecular, cellular, or whole tissue level.
- Recent evidence suggests that multiple, repetitive freeze-thaw cycles are more effective in controlling tumors than a single cycle.

2. **Cryosurgical systems**
   - Liquid nitrogen
     - Liquid nitrogen cooled probes are commonly used for internal use.
     - Cotton swabs dipped in liquid nitrogen are applied externally.
   - Gas-based systems
3. **Cryobiology**
   - Biological cells are primarily water, some are more than 80% water.
   - Sperm-banks and blood banks take advantage of freeze-storing by treating cells with glycerol and supercooling them.
4. **Advantages**
   - A distinct advantage of using cooling versus heat is that cold does not denature proteins the way heat does.
   - Nerve sheaths remain intact and can regenerate sensation in the affected tissue.
   - Absence of pain indicates nerve tissues are deadened as a by-product of the process. This may lead to use during surgery or postoperatively.
   - Cryosurgery is popular in treating prostate cancer, skin cancer, and skin growths.

OBJECTIVE 12 **Complete statements concerning waveforms.**

1. **How waveforms are created**
   - A change in pressure pushes molecules together.
   - With the compaction of molecules there is a change in shape, a deformation.
   - The molecules transmit the change or energy by vibrating or colliding with one another.
   - The pressure change takes the shape of waves.
2. **Waveform characteristics**
   - Wave energy has basic characteristics that can be observed most easily in a liquid form: water.
   - Wave displacement can be measured by distance or time.
   - The oscillation of a water wave is visible, but many waves are not visible to the human eye.

   ✔ **NOTE:** There are other types of waves. Sound waves, light waves, and radio waves share the same characteristics.

- Waveform components
  - Crest or peak—The high point of the wave
  - Trough—The low point of a wave

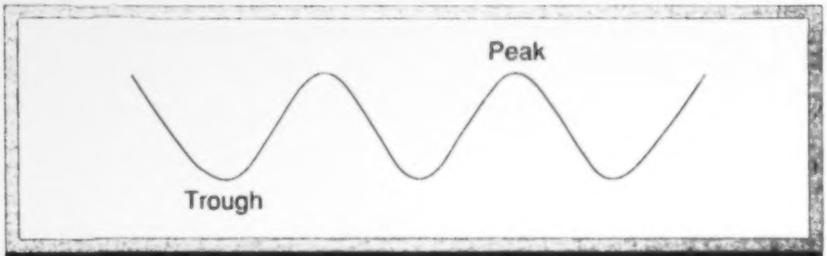

**Figure 8**
Waveform crest and trough

- Wavelength—The distance between one wave crest and the next wave crest or the length of a cycle

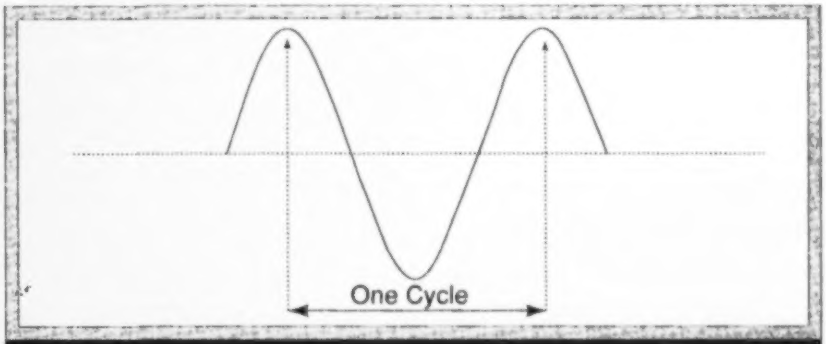

**Figure 9**
Waveform cycle

- Distortion or amplitude—The magnitude of the crest and trough, measured from the midline
  - The bigger or taller the amplitude, the louder the sound. Conversely, the smaller the amplitude, the softer the sound.
  - In sound, it is the loudness of tone.
  - In light, it is the brightness and color.
- Period—Measured in time
  - For light, a period can be measured in time or distance.
  - For sound, a period is measured in 1 second intervals.

- Frequency—Measure of the interval of the wave from peak to peak. The number of times the wavelength repeats within a time period is usually measured in cycles per second or cps.
    - For sound, the faster the oscillation of the wave, the higher the pitch. The slower the oscillation, the lower the pitch.
    - For sound, if there is a change in frequency and the tone has the same pitch and amplitude, it is a harmonic of the lowest fundamental frequency.
    - For light, the faster the oscillation or the higher the frequency, the hotter and more harmful it becomes.
    - Frequency variables
        - Pressure—Speed is also affected by pressure. The greater the pressure, the faster the waves move.
        - Temperature—The speed of the fluctuation is faster in warmer mediums than in colder mediums. Cold air or water slows the wave and warm air or water speeds the wave.
        - Density and elasticity of the matter through which it is passing. Hydrogen passes waves faster than oxygen and speeds are greater with higher salinity.

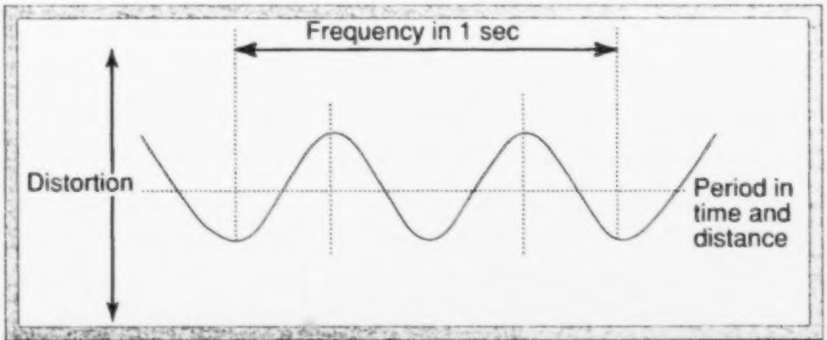

**Figure 10**
Waveform over time and distance

### 3. Factors that affect waves

- Understanding what occurs during reflection is the most critical for understanding ultrasound.
- Refraction occurs when the wave bends or changes course. It may be caused by changes in speed. Doppler relies on this.
- Channeling or ducting are commonly used for endoscopic tools.
- Absorption is used to dampen sound or light.

**Objective 13**

## Describe how ultrasound scans work.

### 1. Ultrasound scans

- Ultrasound waves are used by surgical teams for diagnostic and therapeutic purposes.
- Sound waves reflect off of internal structure boundaries at varying intervals, thus creating a real-time image of structure activity.
- Ultrasound technology measures and records different types of sound waves projected into a segment of the human body.
- Because of its non-invasive and safe nature, ultrasound is considered desirable in observing fetal activity, and also for viewing organs and tumors. Though not its only application, it is certainly the most prevalent.

### 2. Ultrasound types

- Pie-shaped
- Rectangular-shaped
- Two-dimensional vs. three-dimensional ultrasound
  - Ultrasound images are acquired on a two-dimensional plane.
  - Two-dimensional images can be sent to a computer to be "digitally enhanced" and assembled into a three-dimensional image.

### 3. Surgical application

- The sonogram can be used for diagnosis prior to surgery.
- The echocardiogram can be used for monitoring blood flow velocity.
- Transcranial Doppler (TCD) ultrasound can be used for assessments of blood flow velocity in the brain.
- Ultrasound images, both 2D and 3D, can be used in real-time for surgical procedures including ablations, biopsies, and drainages.

**Objective 14**

## Explain how doppler ultrasound works.

### 1. Doppler effect

- When the source of a wave distortion, such as a car, a plane or a train, approaches a specific point, its wavelength decreases while its frequency increases. What this means is that the sound waves are further apart and have a lower pitch, which increase in frequency and pitch as they approach that specific location or object.
- As the source of a wave distortion moves away from that specific point, the opposite occurs: wavelength increases and frequency decreases, dropping the sound back to a lower pitch.

- If there is more than one receptor at more than one location, each receptor will experience a unique wavelength and frequency.

  Examples: Car whooshing by on the freeway or train racing by on the rails; sound moving from one speaker to another at the theater

2. **Doppler ultrasound**

- Doppler ultrasound uses the doppler effect to estimate blood flow or to track the movement of other body fluids.
- Moving red blood cells actually change the frequency of sound waves. When blood cells are moving away from the ultrasound, the signal is more faint. When blood cells are moving towards the ultrasound, the signal increases.
- Results in a reasonably complex picture of blood flow.

3. **Doppler ultrasound types**

- **Continuous wave doppler ultrasound** (CWD)—Tracks high-velocity blood flow in the heart
- **Pulsed wave doppler ultrasound** (PD)—Tracks blood flow in the heart, but is much more location specific and can't accurately measure high-velocity blood flow
- **Color flow doppler ultrasound** (CFD)—Uses PD technology and then imposes computerized coloration to indicate flow and direction in and out of the heart (usually blue and red in color)
- **3D ultrasound** (3DUS)—Uses computer-enhanced features to build a three-dimensional model

OBJECTIVE 15 **Complete statements concerning the dual nature of light.**

1. **Light as a waveform**

- Light acts as a wave.
- Light waveforms have their own brightness and color, determined by frequency and wavelength.
- The only color seen by human eyes is the color that is reflected back and not absorbed.
- The visible light wave spectrum moves from red to orange, then yellow, green, blue, indigo and finally violet.

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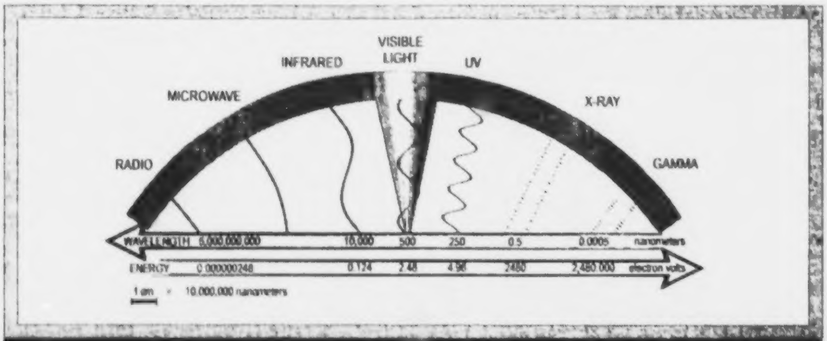
VISIBLE LIGHT
INFRARED
UV
MICROWAVE
X-RAY
RADIO
GAMMA
WAVELENGTH 6,000,000,000 10,000 500 250 0.5 0.0005 nanometers
ENERGY 0.000000248 0.124 2.48 4.96 2480 2,480,000 electron volts
1 cm = 10,000,000 nanometers

**Figure 11**
Visible light region.

Courtesy of NASA/CXC/SAO.

### 2. Light as a particle of energy

- Light also acts as a particle of energy which can be measured in **photons**.
- In our solar system, the sun is our primary source of electromagnetic energy.
- The visible part of light waves is part of the much larger **electromagnetic spectrum**.
- Only parts of the energy generated by the sun reach earth, dependent on altitude and filtering from the ozone layer.
- Light energy is measured in terms of candlepower (photometry).

  Examples: English foot-candles; metric meter-candles

KEY TERMS

**Photons**—A unit of light energy that is analogous to atoms in matter.

**Electromagnetic spectrum**—Light is only a small part of a larger set of wave forms that are comprised of electrical and magnetic fields.

### 3. Light sources

- Sun
- Electricity
- Burning

  Examples: Chemicals, wood, gas, or oil
- Active medium

  Examples: Solid, liquid or gas, such as fluorescence from phosphor or mercury vapor, crystal

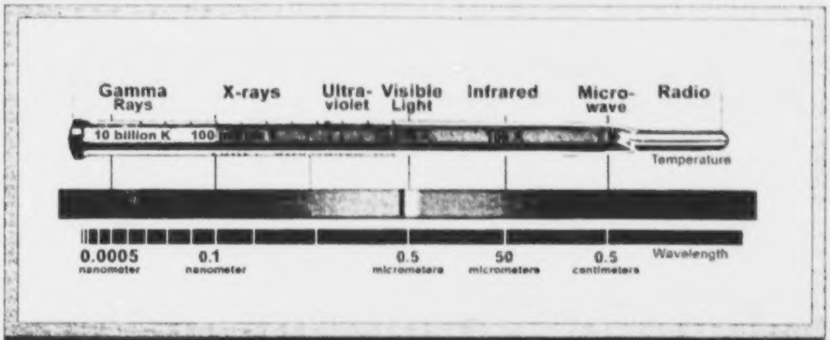
Gamma Rays
X-rays
Ultra-violet
Visible Light
Infrared
Micro-wave
Radio
10 billion K
100
Temperature
0.0005 nanometer
0.1 nanometer
0.5 micrometers
50 micrometers
0.5 centimeters
Wavelength

**Figure 12**
X-rays and temperature

Courtesy of NASA/CXC/SAO.

OBJECTIVE 16 **Match the electromagnetic spectrum types to their correct uses.**

1. **Infrared radiation**
   - Used in thermography to graphically present temperature information in vascular and muscular evaluations
   - Used to treat some forms of cancer
2. **Ultraviolet radiation**
   - Used in the treatment of tuberculosis and exfoliation in skin conditions like psoriasis; counterirritant to lumbago and neuritis
   - Used to sterilize against bacteria, viruses, and other microorganisms
3. **X-ray radiation**
   - Used in diagnosis and treatment
   - Fluoroscopy uses ingested or injected special substances or chemicals that glow under X-ray exposure for observing muscular, vascular or intestinal tract movements.

OBJECTIVE 17 **Select true statements concerning magnetism characteristics.**

1. **Magnetic fields**
   - Magnets have one side that is attracted to the north pole and one side that is attracted to the south pole.
   - When two magnets are brought close together, north and south attract one another, drawing them together.
   - North and north or south and south repulse each other, pushing the magnets apart.

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- The region around the magnet is called the magnetic field and is stronger or weaker, depending on the strength and position of the magnet.
- Magnetic lines of force that attract are stronger with some substances, like iron, nickel or steel than with substances like copper, glass or wood. When attracted, the substance actually concentrates the magnetic line of force and can become a magnet, too. For some substances, this is temporary. For others, it is permanent.

2. **Magnetic and electric fields**
   - Magnetic and electric fields both function based on the balance of attraction and repulsion.
   - Electricity and magnetism often occur in close proximity and work hand in hand.
   - Magnetic fields surround electric fields.
   - When one electric field is brought into close vicinity to another, magnetic force occurs.
3. **Application**

   ✔ **NOTE:** Identifying the effects of magnetic fields in the body is complicated. While the earth's magnetic field is strong, the body's magnetic fields are weak and require highly specialized detectors and a room that is designed to reduce interference and noise in the area.

   - Magnetoencephalography (MEG) and magnetocardiography (MCG) record the magnetic fields generated by the brain and by the heart, respectively.
   - The brain's magnetic field is much weaker than the heart's magnetic field, which is weaker than the lung's magnetic field.
   - The equipment used to record the information is quite expensive and is not readily available at most hospitals.

OBJECTIVE 18 **Distinguish between static and dynamic electricity.**

KEY TERM

**Electricity**—The product of stationary or moving electrons and protons

1. **Static electricity**
   - Generated through friction and an accumulation of charges on a surface
   - A passive by-product of forces
2. **Dynamic electricity**
   - Electrons in motion; a flow of electric charge in a conductive material
   - Generated by radiant, thermal, chemical or mechanical energy

- Types of dynamic electricity
  - Thermoelectricity—Produced by heat
    - Radiant solar panels to photoelectric cells
    - Thermal geothermai energy from volcanic activity to thermocouples (thermoelectricity)
  - Hydroelectricity—Produced by water
  - Piezoelectricity—Produced by pressure on quartz crystals (used in ultrasound)
  - Chemical dry-cell or Nicad batteries
  - Mechanical magnets

OBJECTIVE 19

**Complete statements concerning electricity and electric current.**

1. **Electricity**
   - The result of the interaction of charges, which can exist in nature or be manufactured
   - Most electricity is generated using water, solar, wind or nuclear power.
2. **Electric current**
   - The movement of electrons from the negatively charged side through a conductor (often a wire) to the positively charged side.
   - If an inappropriate amount of electric current flows through the human body, it can cause damage or even death.
3. **Application**
   - Electroencephalography (EEG) via electrodes on the scalp and electrocardiography (ECG) via electrodes placed on the arm, leg, and chest record the electrical pulses generated in the brain and heart, respectively.
   - The body's **electrical fields** are much stronger than its magnetic fields.
   - The equipment used to record this information is readily available at most hospitals.

KEY TERM

**Electrical fields**—Involve work being done by an electric force or against an electric force; energy can be transformed into electricity and electricity is transformed into other forms of energy

Objective 20

**List the physical and biological effects of electric current that prove helpful in medicine.**

1. **Physical effects**
   - **Thermal**—Current flowing through a conductor produces heat. That's why electrical cords are insulated. Some surgical instruments use current to coagulate blood. Heat from current can prevent hemorrhaging.
   - **Magnetic**—Electric current always produces a magnetic field.
   - **Chemical**—Current flowing through a substance can change its chemical composition and even cause disintegration.
   - **Radiant**—Electric current can generate incandescent or fluorescent light. Endoscopes combine electrical current with a light source and a means to carry it down a tube to view and magnify an object.
   - **Mechanical**—Motors use current produced by a generator to create motion. All electric motors use magnets to generate motion and generators create the current the motors use.
2. **Biological effects**
   - **Nerve stimulation**—Internal electrical responses to external current
   - **Therapy**—Movement of muscles or tissue to prevent atrophy or to stimulate strengthening of tissues
   - **Injury**—Overstimulation can lead to fibrillation or shock.

Objective 21

**Complete statements concerning fiber optics.**

1. **Optical fiber is a narrow filament of spun glass or even transparent plastic.**
2. **The primary use of fiber is to deliver light.**
3. **Light most often travels down conventional optical fiber bundles of light-conveying glass or plastic. It is very narrow, so the light bounces back and forth down the filament without dispersing.**
4. **Light sent down a fiber bundle is used to view internal tissue.**
5. **Fiber can also be used to observe surgical progress.**

Objective 22

**Describe how optical fiber is used in endoscopic surgeries.**

1. **Sheds light on the internal organ or cavity, which is inserted into the body via a tiny incision**
2. **Reflects the image in magnified form back to the viewer**

3. **Provides surgeon with significant light to use specific surgical endoscopic tools**
   - Endoscopic scissors (Class I lever)—Cut tissue deep in the body, usually retractable blades
   - Endoscopic electrosurgery (using electricity)—Uses high-energy current to cut tissue or coagulate blood
   - Harmonic scalpel (using ultrasound waves)—Resonates at high frequency; vibrations disturb the tissue proteins or cause coagulation, depending on the blade used
   - Endoscopic ultrasonic surgical aspirator (using ultrasound)—Implodes bubbling of liquid in the tissue; tumors generally contain more water than normal tissue, so this is selective
   - Ligature clip appliers—Stapling device using metal clips
   - YAG, $CO_2$ and Argon laser using light—Cuts, coagulates, or vaporizes using infrared or visible light

**OBJECTIVE 23** **Complete statements concerning the use of lasers in surgery.**

1. **Lasers (Light Amplification by Stimulated Emission of Radiation) produce a beam of light that spans the IR, visible and UV portion of the electromagnetic spectrum.**
2. **Lasers rely on exciting lots of photon activity at once, so that they all travel in the same direction, with the same energy and identical color.**
3. **For lasers, the beam of light is generally sent down an articulated or flexible hollow tube that guides the waves.**
4. **Lasers can also be used as a surgical tool, when focused instead of being dispersed, to divide tissue, to destroy tissue, and to fix tissue together in adhesion.**

**OBJECTIVE 24** **Match laser types to their correct descriptions.**

1. **Ruby lasers**
   - Oldest type from 1960
   - Uses single, synthetic ruby rod between the polarizer and the telescope
   - Used in ophthalmology and dermatology
2. **Helium-neon lasers** (He-Ne)
   - Second generation lasers using neon and helium in a glass tube
   - Used in CT scans and Doppler blood flow scans

3. **Carbon dioxide lasers** ($CO_2$)
   - Third generation laser, gaining in power through the use of molecular gas, a nuclear reaction.
   - Because it covers more of the electromagnetic spectrum, it is very flexible and can be "tuned" to a specific wavelength. The light is sent through a prism and dispersed so that only the selected wavelength is aligned and amplified for output.
   - Used in gynecology, otolaryngology, neurology, and general surgery
4. **Argon and Krypton lasers**
   - Commonly used and often combined into a two-tube system so that one or the other can be selected at the push of a button.
   - Nuclear, as well, through the use of molecular gas. In this instance, the gas is contained in a graphite or beryllium oxide plasma tube and requires extensive water or air-cooling, respectively.
   - Krypton is not as flexible and is restricted in its use.
   - Used in ophthalmology and dermatology
5. **Neodymium Yttrium-aluminum-garnet (Nd-YAG) lasers**
   - Commonly used and similar in function to the original ruby lasers, but through a YAG tube, which is much more efficient and can be tuned.
   - Used in gastroenterology, urology, and bronchial work

OBJECTIVE 25 **Select true statements concerning uses for nuclear medicine in surgery.**

1. **Diagnosis**—Diagnosing internal organs without damaging them has been the focus of surgeons for some time.
   - Structural—Defines shape, size and edges of the object
   - Functional—Alters, changes or affects the function of a specific organ or tumor or growth
2. **Radiotherapy**—Radiation exposure through exposure, inhalation and ingestion or injection
   - Radionuclides
   - Radiopharmaceuticals
3. **Examples**
   - Structural—Defines shape, size, edges of object
     - CAT (Computed Axial Tomography) or CT Scan—X-rays are taken in multiple cross-sections of the patient's skeletal and tissue structure. These are used to reconstruct a digital image of the patient. The digitized version overlays organs into the skeletal structure, making growths, lesions, abnormalities and any low-contrast differences more available to the surgeon.

- NMRI (Nuclear Magnetic Resonance Imaging) or MRI—Cross-sectional imaging that tracks how energy is absorbed by magnetic nuclei when exposed to a static magnetic field passed over the body. The responses show concentration levels of certain molecules. Then, it contrasts this with areas of lesser concentration to show the structural makeup of internal organs. Does not require ingestion or injection of a substance. Strict safety regulations are in place related to any metal in the area, since the magnetic forces are so strong.

- NMRS and p or cNMRS—Nuclear Magnetic Resonance Spectroscopy and Phosphorous or C-isotope MRS. Similar to MRI, but must have a "homogenous" magnetic field for the entire sampling. This requires a circular spectrometer. NMRS tracks the energy transfer of phosphorous compounds, and NMRS traces the C-isotopes in the body.

- **Functional**—Changes, affects specific organ or tumor function

  - PET and SPECT—Positron Emission Tomography and Single Photon Emission Tomography. Measures emissions of special nuclear tracers (isotopes) that have been injected into the blood stream and then travel to the brain. Brain activity is then recorded, digitized and converted into a three-dimensional map of the brain or organ. SPECT uses isotopes that have a much longer shelf-life, but achieves the same net results.

  - EEG and MEG—ElectroEncephalography and MagnetoEncephalography. Records the activity in the brain in response to some sort of stimulus. The EEG uses electrodes placed on the scalp. The MEG makes use of magnets to the same end.

  - FMRI—Functional Magnetic Resonance Imaging. Similar to MRI, but records the functions of the organ, instead of its structure. It can track neural activity, blood flow, oxygen levels, etc.

OBJECTIVE 26

**Complete statements concerning CT scans.**

1. **CT slices**

✔ **NOTE:** Computed (Axial) Tomography uses lots of tiny scans, each called a slice. Tomos, the Latin root, means slice.

- Originally slices were linear, proceeding to X-ray on the x-axis, then the y-axis.
- Next, a wider fan-like beam and a wide-angled detector rotated slightly around the object.
- Finally, full rotation with a circular ring detector and a circular rotation of the X-ray completely surrounded the entire object.

2. **CT types**

- Linear or back-projection CT—X-ray slices are taken at 90° angles on a linear or flat plane.

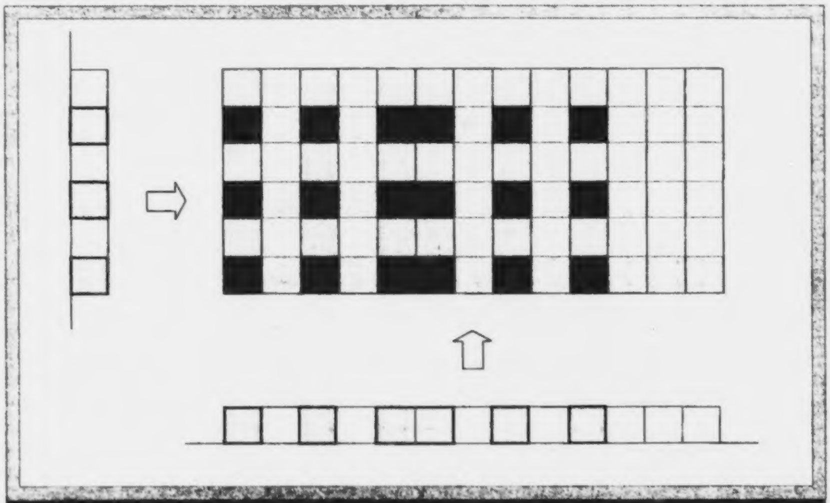

**Figure 13**
Linear CT scan

3. **Helical or spiral CT**—X-ray slices are taken as the source and detector rotate around the patient while moving along the gantry on the X-axis.

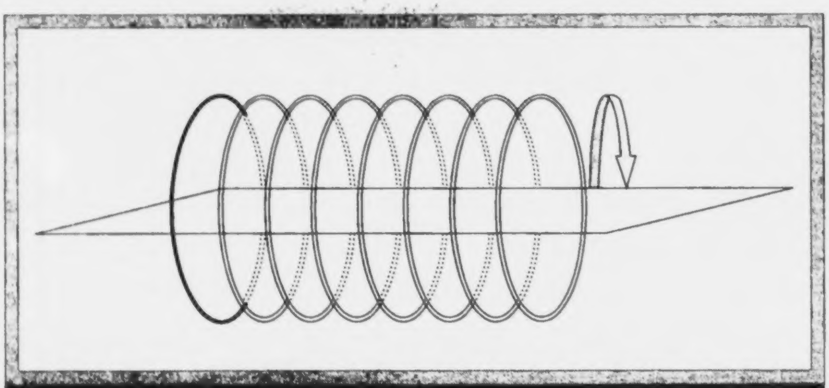

**Figure 14**
Helical CT scan

**OBJECTIVE 27**

**Explain the importance of setting and measuring irradiation dosage.**

1. **History**

- In 1895, Wilhelm Roentgen discovered X-rays.
- As those early experimenters quickly discovered, there were strong benefits and equally stark dangers associated with exposure.
- Many early experiments left burns and some lifelong scars. It was common for early experimenters to die of leukemia.
- Within 20 years of Roentgen's discovery of X-rays, there was an organized task force in Britain to ensure public and professional safety.

2. **Safety standards**

- The International Commission on Radiological Protection (ICRP) is an organization that sets safety standards for irradiation dosages.
- ICRP makes recommendations for radiation safety, including quantity of exposure and the regulation of medical exposure, both to practitioners and those being treated.

3. **Recommended dosage intake limits**

- Set by the ICRP and MIRD (Medical Internal Radiation Dose) Committee standards for diagnostic and therapeutic use.
- Encompasses both the diagnosis and treatment of patients receiving radionuclides or radiopharmaceuticals during radiotherapy.
- The amount (dosage) used must minimize harmful effects and maximize therapeutic effects.
- Limits intake through exposure, inhalation, and ingestion.

4. **Harm**

- An excessive external or internal dose can cause harm.
- External dosage
  - — Due to radiation outside of the body, through natural, intentional and unintentional exposure
  - — No physical contact with the source
  - — When recipient is removed from the source, exposure ceases
- Internal dosage
  - — Irradiation is absorbed through the skin, ingested or inhaled
  - — Once in the body, exposure continues

5. **Recommended Annual Limit of Intake (ALI)**
   - General public—1 mSv per year
   - Occupational exposure—20 mSv per year effective whole body dose
   - Medical exposure—Not to exceed the justifiable benefit to patient
6. **Areas of susceptibility**
   - Lens of the eye (most sensitive organ to irradiation)
   - Skin
   - Gastrointestinal tract for ingested radionuclides
   - Reproductive organs
   - Hands and feet
   - Bones

OBJECTIVE 28 **List methods for protecting against occupational irradiation.**

✔ **NOTE:** No distinctions are made between diagnostic and therapeutic radiation in this objective.

1. **Minimize exposure time**
2. **Maximize distance from source of radiation**
3. **Shield both the radiation source and primary or secondary irradiation recipients**
4. **Radiation detection**
   - Since irradiation cannot be sensed, instruments have been designed to measure radiation.
   - The radiation source, the radiation field and personnel should be monitored for irradiation dosage.
   - Detection options
     - — Chamber
     - — Counter
     - — Film
     - — Dosimeter
     - — Film Badge
     - — Thermoluminescent
     - — Electronic
     - — Bubble
     - — Calorimeter

# Student Supplement 1—Motion and the Human Body

**INTRODUCTION**

Human motion is often taken for granted. However, for the human body to move smoothly and freely, many structures must work together seamlessly. Bones, muscles, ligaments and cartilage form the framework of the human body that allow for movement. Body motion falls into three basic categories: uni-, bi- and triaxial.

- Uniaxial (single axis)
    - Hinge—Elbow (radius) or knee (trochlea) joint
    - Saddle—Thumb joint (between metacarpal and trapzium)
    - Pivot—Movement constrained by the ligaments around the radius on the ulna
- Biaxial (double axis)
    - Gliding—Hands and feet (between carpals)
    - Elliptical—Hands and feet (radius on carpals, and between carpals and phalanges)
- Triaxial (triple axis)
    - Ball and socket—Shoulder and hip (ball of humerus and ball of the femur)

**LEVERAGE CLASSES**

Body motion requires muscles to leverage against pivot points called joints, rotate around the spinal column and neck, or open and close on hinges. Most body motion uses leverage.

- Class I—The fulcrum is placed between effort and resistance

Common examples: Surgical scissors, retractors, old-style balance-beam "justice" scale, crowbar or teeter-totter. Also includes the wheel and axle, with adaptations like doorknobs, keys and screwdrivers.

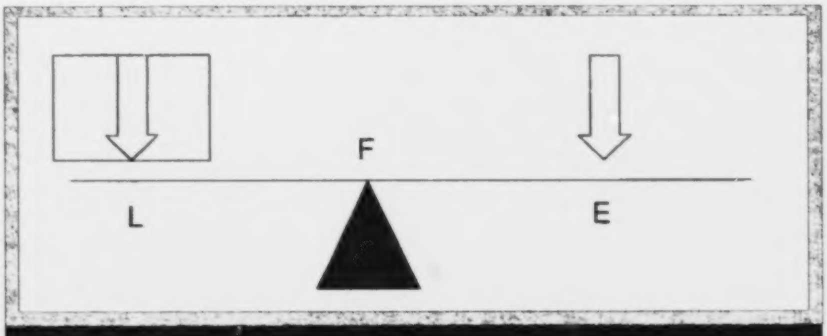

**Figure 1**
Class I lever diagram

Body examples: Nodding of head, curling of biceps, and bending of elbow

- Class II—Resistance is between the fulcrum and effort.

  Common examples: Moving dolly, bottle opener, wheelbarrow

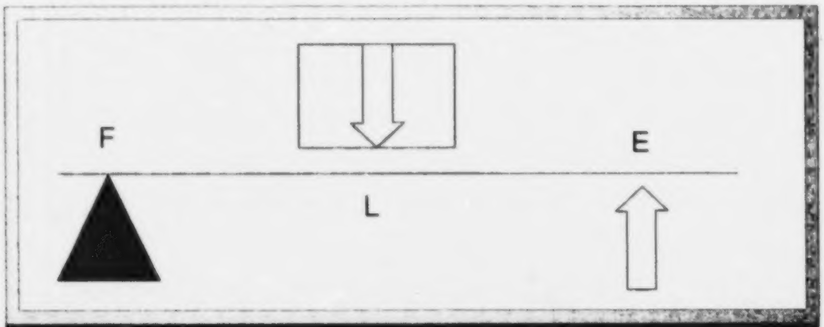

**Figure 2**
Class II lever diagram

  Body examples: Turning a mattress, performing push-ups, or rising on the ball of your foot

- Class III—Effort is between the fulcrum and resistance.

  Common examples: Forceps or lifting material in a shovel

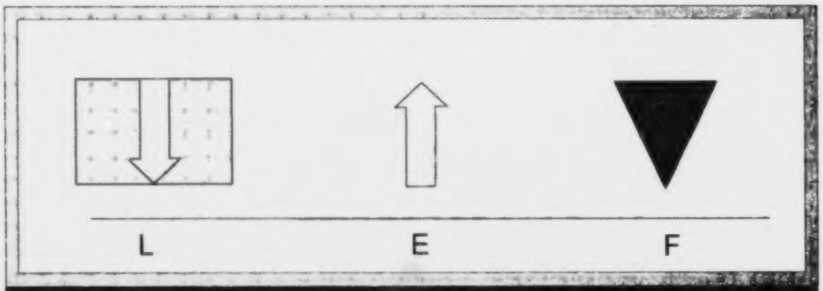

**Figure 3**
Class III lever diagram

  Body examples: Lifting a drink or lifting weights from the shoulder

## Student Supplement 2—Understanding Matter and Energy

### Introduction

All matter is a composite of molecules, which are comprised of atoms. Atoms have a nucleus surrounded by outer layers called the orbital. The atom has some degree of energy and is comprised of three components:

- Proton—Has a positive charge, remains in nucleus with neutron
- Neutron—Is neutral, i.e., no charge, remains in nucleus with proton
- Electron—Has a negative charge, occupies the orbital surrounding the nucleus

### Energy

- All atoms are electrically neutral, but yet have an electrical nature.
- Excess energy is created when the atom absorbs a photon, which is a form of light, or when it collides with other atoms or particles.
- When an electron is free-floating, it is "ionized" and the atom then has a net positive charge.
- Each type of element has a different sort of energy associated with it, so the atoms in a given element respond in a unique way to other atoms.

### Radioactivity

- All atoms can be ionized by an exchange of electrons.
- Only certain elements will give off protons or neutrons or allow a change in the nucleus.
- Radioactivity occurs when radiation is emitted as the nucleus is transformed into another element.
- Alpha and Beta particles are sometimes emitted during the transformation.

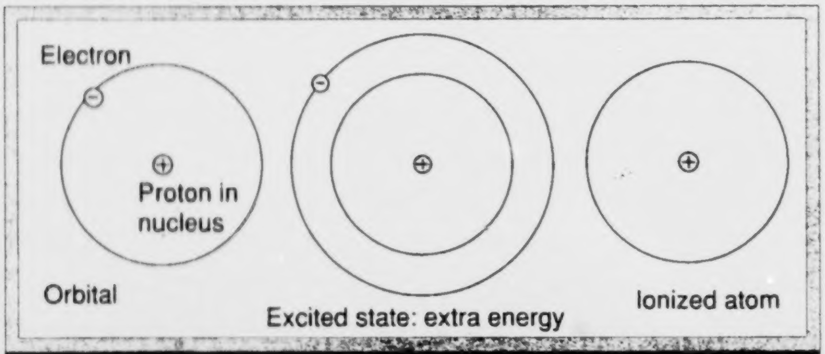

**Figure 1**
Atom components

## Student Supplement 3—Waves

**WAVE CHARACTERISTICS**

Waves undulate up and down in a rhythm, like waves of water. This movement is based on some sort of disturbance or exchange of energy, traveling from one point to another. Waves all have a crest, the highest point of the wave, and a trough, the lowest point of the wave. Both sound and light are forms of energy that travel in the form of waves.

- Wavelength—The measure of a complete wave or cycle from crest to crest or trough to trough
- Amplitude—The measure of half a wave, from midpoint to peak or midpoint to trough
- Frequency—Waves are measured in terms of the number of waves, too. Crests and troughs occur over time, and the total number of waves that pass a given point in a one second time span gives us its frequency value. Each crest and trough is considered a cycle, so frequency is measured in cycles per second (cps) or in Hertz (Hz).

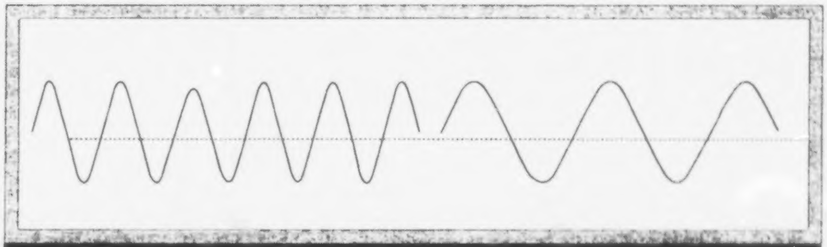

**Figure 1**
Hi/Lo pitch

## Student Supplement 4—Sound Waves

### INTRODUCTION

Sound waves are a little different than any other waves. Unlike light waves, sound waves cannot operate in a vacuum. Sound waves are a form of pressure that cause some sort of medium to oscillate or vibrate. This medium must be made of molecules, which includes air, water or even solid materials like stone. Loudness, distance, volume, pitch and resonance all affect what is heard of the sound wave.

### SOUND CHARACTERISTICS

- Speed of sound—Sound travels a million times slower than light. The speed of sound is also known as sonic sound or Mach 1. This may sound familiar to those who love airplanes or space flight, since Mach 1, Mach 2, Mach 3, etc. are all multiples of the speed of sound. Supersonic aircraft, which break the sound barrier, leave behind a trail of shock waves known as a sonic boom. Factors that influence the speed of sound include:
  - Medium—The form of matter that conducts the sound.
  - Pressure—The higher the pressure, the faster the sound.
  - Density—The more dense the matter, the slower the speed of sound.
  - Elasticity—A more elastic medium transmits sound faster.
  - Temperature—Temperature influences density. The warmer the medium, the faster the sound.
- Sound conductors—Some forms of matter conduct sound better than others. Remember, sound cannot travel in a vacuum, so there is no sound in space.
  - Solids, apart from a vacuum, conduct sound the fastest. Metals are superior to other solids. In fact, steel conducts sound 5 times faster than salt water and 15 times faster than air. Tuning forks are made from metal.
  - Liquids work reasonably well as sound conductors. In fact, sound travels 5 times faster through salt water than it does through air. A saline solution increases the speed of sound just slightly over fresh water.
  - Gases don't conduct sound very well. Consider the time it takes to hear lightning, which is usually well beyond when you've seen it. However, in helium, sound travels 3 times faster than in air. The higher pitch of the voices of astronauts means the sound is moving faster. So, too, sucking on a helium balloon to make a squeaky voice.

- Sound transmission
  - Reflectance—Sounds normally follow a path, but this path can be altered when the sound bounces off of a surface. If it disperses into multiple paths after bouncing off a surface, the sound is scattered.
  - The Doppler effect—Sound waves are reflected by any surface that is in the path of its transmission. For this reason, even if an orderly can't see around a corner, the orderly may be able to hear the roll of a gurney towards OR. In fact, even with eyes closed, the orderly might be able to identify where the gurney was prior to reaching the hall and after passing down the hall. This is known as the Doppler effect, where the pitch of the sound is lower as it approaches, higher as it arrives, then lower again as it moves back away. This is used to great effect in movie theaters. It is also used extensively with Doppler ultrasounds.
  - Refraction—When sound waves bend and change course based on the factors influencing its speed.
  - Absorption—When sound waves travel through a medium, some of their energy is used up by the medium itself. Interestingly enough, higher frequencies lose more of their energy to a medium faster than lower frequencies do.

**TYPES OF SOUND**

Human ears cannot detect all sounds.

- Ultrasonic sound—Sound that is too high to be heard by humans. Sonar uses ultrasound to search for hidden objects, to measure distance, etc. by measuring the frequency of the echoes that come back from the sound sent out.
- Auditory sound—Sounds heard by humans; generally in the frequencies between 20 to 20,000 Hz
- Infrasonic sound—Sound too low to be heard by humans

**COMPONENTS OF SOUND**

- Pitch—The speed of an oscillating sound wave. Faster oscillation creates higher tones. Slower oscillations make lower tones. Sound waves move faster in warmer temperatures and slower in freezing temperatures. Think about the increase in pitch and speed as the teakettle comes to a boil.
- Amplitude—The intensity or loudness of the sound; measured in decibels (dB)
- Resonance—Some surfaces reflect sound and others absorb it. If the surface is able to oscillate or vibrate in sympathy to the sound wave, it will reverberate at the same frequency.
- Harmonics—Two tones that have the same pitch and the same amplitude, but differ in frequency. The lowest frequency is also called the "fundamental" frequency and all others are multiples of it. There can be many additional tones that have the same amplitude but occur with greater frequency and are thus, higher and higher pitched. If there are enough harmonics at multiples of a high frequency, significant oscillation occurs.

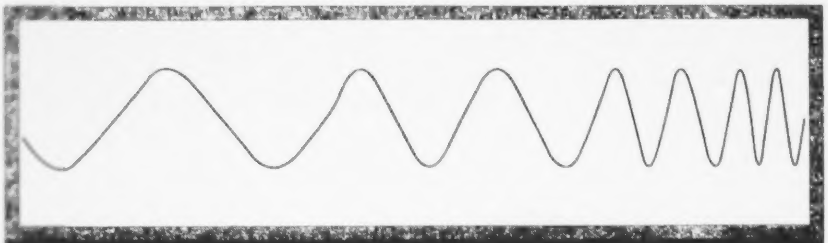

**Figure 1**
Fundamental harmonic

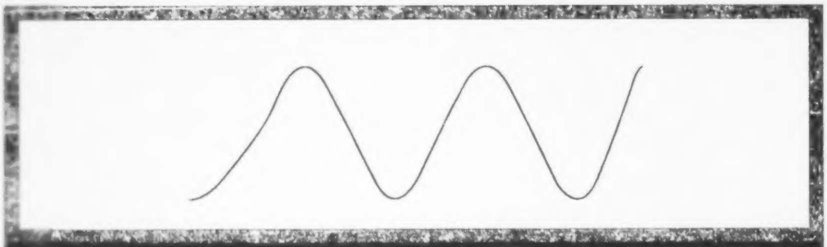

**Figure 2**
2nd harmonic

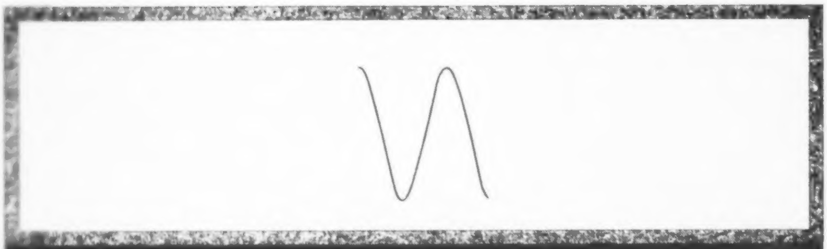

**Figure 3**
3rd harmonic

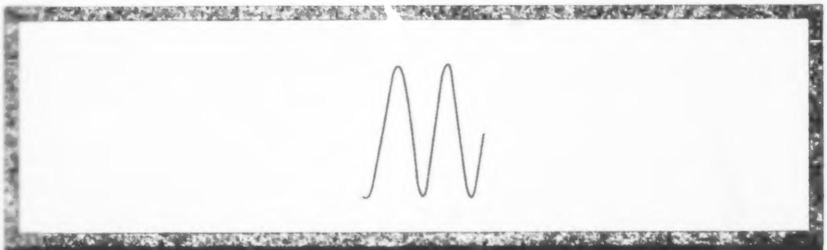

**Figure 4**
4th harmonic

**APPLICATION**

- Ultrasound, sounds that are higher than human ears can hear, have been used to great effect on human tissue and bones. Transducers vibrate, sending a beam of ultrasonic waves. Ultrasonic signals in the body respond like sonar does in the ocean. Since a large part of the body contains fluids, ultrasound passes quite well through soft tissues such as blood vessels and muscles. Harder tissues like bones, cartilage and ligaments reflect the sound back instead of transmitting it further. The waves are reflected from boundaries between structures like tumors or organs or pockets of fluid, which are then captured by the equipment for evaluation. For this reason, ultrasound offers a non-invasive and safe method of diagnosis for many organs, tracts and cavities of the body. Use of the Doppler shift, which measures sound waves as they strike moving surfaces, has been used to determine the speed of the fetal heart rate and to monitor blood flow and the movement of body fluids. Echocardiograms, which use ultrasonic signals to record heart rate, send signals through the chest at a given rate. The responses can be seen as an image that helps identify heart valve action and any abnormalities in the vascular system. At many hospitals, ultrasonic systems are being utilized to produce shock waves that help disintegrate kidney stones.

- Infrasonic equipment is being used to focus waves on specific acupuncture sites, for muscular or vertebral difficulties and for easing stiffness or inflammation of tissue. In fact, some infrasonic equipment is being used to mitigate post-surgical pain and to monitor heart and breathing activity.

- Harmonic scalpels make great use of the multiple frequencies that cause significant harmonic oscillation, as described earlier. This enables surgeons to cut and cauterize tissue with a very fine instrument.

- Stethoscopes rely on sounds conducted over the surface of the bell-shaped diaphragm, which then are passed through the tubing to the listener. Symbalaphones operate identically, but are used to compare sounds from two diaphragms instead of one.

## Student Supplement 5—Electromagnetic Spectrum

**ELECTROMAGNETIC WAVES**

- Oscillating patterns of electric and magnetic fields are known as electromagnetic waves. Electromagnetic waves vary in size from extremely long waves with a wavelength as spread out as a gymnasium to very short waves with a wavelength smaller than a portion of an atom. Electromagnetic waves are waves of radiation that span radio, television, microwave and light waves. They also include X-rays and gamma rays. As the wavelengths decrease, it no longer makes sense to speak of them in terms of wavelength, since some light waves, X-rays, and gamma rays act more like particles and less like waves. For this reason, the electromagnetic spectrum is discussed in terms of wavelength, energy or frequency.

**RADIO AND MICROWAVE**

- Because of their long wavelength, these waves have less energy. Nonetheless, heat is generated when these waves move molecules without breaking them. Radio and TV electromagnetic radiation (EMR) use the lowest frequency bandwidths and are generated by electronics. Microwave EMR is in the next lowest frequency bandwidth.

**LIGHT WAVES**

- Light waves can travel without going through a medium, so they travel through space just as easily as they travel through our atmosphere and through matter: solid, liquid or gas. However, light waves are still influenced by matter. When light passes from one substance to another, it is influenced in two ways: it appears to 'bend' at the junction of the two substances and the speed at which it was traveling is altered. Light waves are measured in amplitude, their size, or frequency, the number of waves per second.

- Light speed—Light travels faster through some mediums than others. Light waves travel incredibly fast and move up and down (oscillation) millions and millions of times in a single second.
    - A vacuum provides light with its fastest traveling speed, space being the prime example of this.
    - In air, light travels just a bit slower than in a vacuum.
    - In liquids such as water, light slows even further and disperses more readily.
    - In solids, such as glass, light travels even slower. Lenses and prisms comprised of glass and plastic are fine examples of this. Metals and stone are examples of substances impenetrable by light, though they may reflect and refract light.

- Types of light—There are segments of the light spectrum that are visible to human eyes, while others are not. Light waves occupy the EMR midrange. The full spectrum of light is included in what is called the electromagnetic spectrum. The slowest light waves are infrared, then the visible spectrum seen in prisms and light catchers, then ultraviolet.
    - Infrared
        - Infrared (IR) light has less energy than other light waves. It can produce heat, but not change molecules.
        - It is outside of the visible range of light and closest to visible red rays.

  - Infrared spectroscopy is used to analyze body fluids and human tissues. Infrared thermography tracks temperatures in the body and in equipment and helps during medical vascular and muscular evaluations.
  - Infrared is even being used to detect breast cancer and in special thermometers. There is new technology being developed to deliver special tagged material to a specific cancerous areas, then destroy the tagged material and cancerous cells with infrared, while leaving the healthy cells undamaged. Infrared is also included in the use of lasers.
- Visible light waves
  - Visible light waves are right in the middle. Strong enough to cause some changes in the most fragile molecules, but not strong enough to really effect change in most molecules.
  - Spectroscopy allows us to break light down into its respective wavelengths, seen in bands of color. The same colors are seen in the rainbow, which is a gigantic sky prism.
  - Liquids and solids that are heated to incandescence produce a full spectrum: red, orange, yellow, green, blue, indigo and violet. Incandescent gases only produce the bands of color that are particular to that gas.
- Ultraviolet
  - Ultraviolet (UV) light is a shorter wavelength with more energy and therefore can cause more damage. It can ionize molecules.
  - It is also outside the visible range of light, closest to visible violet rays.
  - Solar UV Radiation (UVR) is tracked with the UV-index and included in many weather forecasts, since it can be damaging to human skin.
  - It can also destroy fungal, viral and bacterial growth, so often it is used in sterilization and curing processes.
  - Ultraviolet is used in medical-grade adhesives, coatings and inks, as well.
  - UV photography can help detect skin damage and skin cancer and profile the patient to validate their improvement.
  - There are three bands of UV rays: Ultraviolet A, B and C.
  - UVA rays have a frequency from 320 nm to 400 nm. UVA light is used frequently in tanning beds. Ninety to ninety-five percent of natural light is UVA. Between 1–5% of the sun's rays that reach us are UVB rays.
  - UVB rays have a frequency from 280 nm to 320 nm. UVB is responsible for premature aging, burns and skin cancer, yet is often used in therapeutic treatment for skin disorders. This is because in addition to stimulating the production of melanin, which is what causes the skin to tan, UVB also assists in the synthesis of Vitamin D. Calcium is more readily absorbed after UVB exposure.

  - UVC rays have a frequency from 200 nm to 290 nm. UVC is germicidal and is also used in ultraviolet phototherapy. Photosensitizers can be applied on the skin or ingested, and then the target area is exposed to UV radiation. This can halt the proliferation of psoriasis, herpes and some skin cancer by inactivating the DNA in unhealthy cells.

- X-rays
  - X-rays have more energy and a higher frequency than any other wave except gamma rays. They can also ionize or break molecular structures. They are a product of the collision of electrons with a specific target. Stars and the sun emit X-rays. Most often, X-rays are described in terms of their energy level instead of their wavelength.
  - Soft X-rays don't produce any noticeable change in tissue, so they are used for diagnostics.
  - Hard X-rays penetrate the tissue more deeply and cause chemical changes, so they are used in therapy for treating cancer and destroying tumors.
  - In the case of diagnostic use, X-rays pass through the body, affecting a photographic plate behind it. The film is then developed, producing a "negative" photograph. X-ray film captures the shadows of those parts of our body that don't allow the X-rays to pass through (like the skeleton) and contrasts them with those that do, like soft tissues. Those areas where the X-rays pass through easily look dark, whereas metal, abnormal growths or bones that are more dense and don't allow the rays to pass through appear lighter or even white, depending on their density.
  - Most X-rays pass through the body, but the ones that don't can cause damage if the volume of those left is high enough. For this reason, patients are generally not at risk, since dosage and frequency is normally low. However, radiographers who incorporate X-rays into their daily routine can be at considerable risk. A dangerous dosage of X-rays could lead to cancer or cell damage, particularly in the reproductive areas.

- Gamma rays
  - Finally, there are gamma rays. They have the highest wavelength frequency and give off the most energy of all waves in the electromagnetic spectrum. They can also penetrate the human body the most deeply and cannot be completely absorbed. Very little besides concrete, lead or steel will stop gamma rays.
  - Gamma rays are produced in space, but those on earth are products of nuclear reactions or nuclear accelerations.
  - Gamma rays have specific, fixed wavelengths based on the radioactive material.
  - Most people link gamma rays with nuclear explosions or nuclear reactor meltdowns. Gamma rays can kill living cells, but they are sometimes used in treatment by focusing them on killing cancerous cells.

- What about Alpha or Beta rays?
  - Alpha and Beta rays are not waves at all, but high-energy particles released from unstable nuclei.

1) Alpha rays are so weak they can be stopped by a piece of paper.

2) Beta rays can be stopped by glass or aluminum.

- External irradiation is not a threat for either of them, so they cannot be stopped through radiation treatment.
- Ingestion or inhalation, however, is an issue.

Examples: Radon gas buildup in enclosed basements of homes built on ground with high radioactivity is a health threat. Mining radioactive materials is an even bigger health threat.

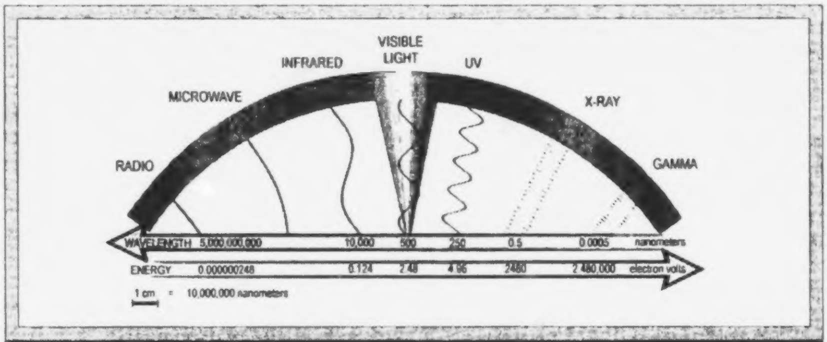
VISIBLE LIGHT
INFRARED
UV
MICROWAVE
X-RAY
RADIO
GAMMA
WAVELENGTH
5,000,000,000
10,000
500
250
0.5
0.0005
nanometers
ENERGY
0.000000248
0.124
2.48
4.96
2480
2,480,000
electron volts
1 cm = 10,000,000 nanometers

**Figure 1**
Visible light region

Courtesy of NASA/CXC/SAO.

**APPLICATION**

- Lasers use a single color and a single wavelength of light, which are synchronized and focused, instead of being spread out like ordinary light. This creates intense levels of heat. Laser light can travel huge distances, as well. For this reason, surgical lasers are lower-powered lasers. Industrial lasers can cut through metal.
- Fiber optics allow laser light to bounce down rods of glass or plastic. Medical uses include laparoscopic surgery and data communications for computers.
- Fluoroscopy is an enhanced x-ray that assists in diagnosis or aids a surgeon real-time to determine the positions of structures and instruments.
- Microscopes
  - Light microscopes use a series of lenses that help magnify an object and light that is reflected up through the glass slide and passes through the lenses to the eyepiece.
  - Electron microscopes uses beams of electrons instead of light rays, allowing for much higher levels of magnification.

## Student Supplement 6—Electricity and Surgery

**INTRODUCTION**

Electricity is an energy based on an exchange of energy in atoms. This energy can be harnessed and converted into many forms of useful energy. Most of our existence depends on electricity: heat, light, etc.

**STATIC ELECTRICITY**

- Static electricity is generated through friction, which gives the electrons in atoms an extra charge. These charges accumulate on a surface of the items in friction until it is discharged. Consider rubbing a balloon on human hair.
- Static electricity occurs when a balloon is rubbed in the hair. Its discharge can be observed by touching metal after shuffling across a floor or rug.
- Nylon or Dacron uniforms are discouraged in the surgical setting because of static buildup and where anesthetics and chemicals are a potential danger.
- It is also imperative that all operating room equipment be properly grounded to prevent electrostatic discharge (ESD).

**DYNAMIC ELECTRICITY**

- Dynamic electricity depends on a constant source of electrons in motion. Electrical current passes from one point to another at the speed of light when there is a difference between the two points. Its source is radiant, thermal, chemical or mechanical.
- Radiant (solar panels to photoelectric cells)
- Thermal (geothermal energy from volcanic activity to thermocouples)
- Chemical (dry-cell or Nicad batteries)
- Mechanical (electromagnetic)—This is by far the most prolific source and uses magnets.

**EFFECTS OF ELECTRICITY**

- Electrical activity is fundamental to the function of the human body.
- Most organs, including the heart and the brain, function via electrical activity. Nerves and muscles conduct electrical signals. Fluids in the body are capable of carrying a charge and human tissues respond to electrical stimuli.
- As seen before, that which can be helpful can also be destructive. Deliberate application of electricity to the human body is done carefully.
  - Currents used in electric shock therapy may assist in changing the function of the central nervous system.
  - Electrical shock can result in damage to the brain, respiratory failure, and cardiac arrest or heart fibrillation. When the heart is in fibrillation, each part is operating independently. A counter shock, defibrillation, can sometimes bring the heart back to a functional state.

**APPLICATION**

- Electrodiagnosis is used to see how responsive muscles and nerves are to electric current.
- Electrocardiography (EKG or ECG) monitors the heart for electrical change. Electromyography (EMG) does the same for electrical activity in muscles and nerves.
- Electrotherapy, such as diathermy, assists in deep or surface heating of tissue for therapeutic reasons. It can be used to increase blood flow, for relief of bronchitis or to mitigate skeletal or muscular pain. This can be accomplished with pancake heat coils, electrode pads, cuff electrodes, or with electromagnetic waves.
- Electric pacemakers for the brain help diminish seizures. Pacemakers for the heart assist in maintaining a regular heartbeat.

**WORKPLACE SAFETY**

- Electrosurgical risks

  ✔ **NOTE:** Thermal injuries are always a risk when dealing with electrosurgery. The most common cause of injury is improper grounding of the patient. This is for several reasons: The return path may not always be the path of least resistance. Generally, this occurs if path from the plate to the unit is poor or if the connection from the pad to the patient is poor. There are several means of monitoring the former situation, where alarms sound when the output is inhibited via a continuity monitor. However, the connection between the patient and the pad or neutral electrodes is not as simple to monitor, so more emphasis is placed on "good practice" in positioning and applying the plate or electrodes. There have been instances where drapes, gowns and anesthetic equipment have caught fire, as well.

  - Unipolar units—Where current flows through the patient before returning to the unit. Here, damage can be quite extensive and may take as long as two weeks before symptoms appear, primarily through fever and pain. Many thermal injuries to organs heal without requiring further surgery. The higher the current, the more extensive and serious the injury can be.
  - Bipolar units—Isolated systems where current flows between the tips of the electrode. Damage is limited to the material or tissue between the tips of electrode or the prongs of the forceps.
  - Grounding plates—Usually a semi-rigid stainless steel plate placed under the patient. Good connection is based on weight, since the plate cannot be molded to fit the patient.
  - Electrodes—Semi- disposable or disposable, usually used dry or pregelled and put in contact with a fleshy part of skin

- Laser surgery risks

✔ **NOTE:** One would think that risks drop with a more localized, specific application. While no current flows through the patient, overshooting the laser beam can damage tissue.

- Thermal injury—Temperature increases destroy tissue, including protein denaturization and enzyme inactivation. Most often, the emphasis is on localized, specific breakdowns so that the damage is confined.
- Electrical-breakdown injury—The electrical breakdown of tissue can occur if the exposure, duration or electrical field strength is high enough.
- Irradiation—Both visible, infrared and UV radiation occur, and long exposure can cause damage, particularly to the eyes, which are the most sensitive to the electromagnetic spectrum.

**OBJECTIVE 29**

# Assignment Sheet 1—Apply Motion and Leverage to the Workplace

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly and correctly | ______ |
| • Correct grammar, punctuation, and spelling were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

______________________________

______________________________

**INTRODUCTION**

Fundamental physics principles underlie many medical practices. This assignment focuses on force and pressure. These concepts will greatly enhance a broad understanding of the function of equipment and everyday procedures. It may also be helpful in creative problem solving.

**DIRECTIONS**

Respond to each question or situation, then have your instructor evaluate.

1. Explain how each of the three laws of motion applies to the hospital setting.
   a. Friction's influence on rest vs. motion—______________________________

   ______________________________

   ______________________________

   b. Imbalanced force and its influence on acceleration and deceleration— ______

   ______________________________

   ______________________________

   c. Force pairs— ______________________________

   ______________________________

   ______________________________

2. Explain the results of a hematocrit and the influence of centrifugal force. Describe the result differences if spun at 400 rpms vs. 4000 rpms.

3. You have just been scheduled to assist with a cardiopulmonary bypass. Central processing has sent up an enclosed cart with all of the necessary equipment. The Mayo kit is on the bottommost shelf to the very rear of the enclosed cart. You are in a hurry, since they have pushed the scheduled surgery up by 15 minutes. As you reach for it, you lose your center of gravity and begin to fall forward with its weight. Explain the forces at work, using the three laws of motion and recommend a course of action that would change the scenario to a safe and aseptic one.

**OBJECTIVE 30**

## Assignment Sheet 2—Evaluate States of Matter

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, spelling and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

______________________________

______________________________

**INTRODUCTION** The movement of matter creates heat energy. As a surgical technologist, it is important to understand the implications of overheating and heat loss. Therapeutic use of heat and cold is regularly used in surgical procedures. Complications and damage can occur from improper application or overexposure during surgery.

**DIRECTIONS** Respond to each question or situation, then have your instructor evaluate.

1. Describe the movement or transfer of heat, based on a differential between two objects.

______________________________

______________________________

______________________________

2. Describe the three types of heat transfer.

______________________________

______________________________

______________________________

______________________________

______________________________

3. Briefly describe at least four different effects of intentional heat, with at least one of each being constructive or destructive.

4. Apply the use of cryosurgery and why, in some instances, it is much preferred over hyperthermia or laser treatments.

5. The temperature in the OR is cool. You have been prepping the room for the past fifteen minutes and moving about fairly rapidly. There is a delay in patient arrival and the surgeon has been waiting. Several sharp words have been directed your way and you sense criticism and impatience. The anesthetist efficiently puts the patient under and surgery begins. Sweat has begun to trickle down your face and your skin feels clammy.

   a. Explain the forces at work to activate simultaneous heating and cooling of your body.

   b. What are the ramifications?

   c. Determine what should be done to mitigate fluctuations in body temperature and suggest methods for altering the situation.

6. There is a complication during laparoscopic surgery. The ground path between the patient's grounding pad and the unipolar cautery unit was inadequate. As a result, high-resistance build-up resulted in some significant damage to the patient's duodenum.

   a. Explain the damage. ______________________________

   ______________________________

   ______________________________

   b. Will it heal with non-operative management? ______________________________

   ______________________________

   ______________________________

   c. List two alternatives that might have lessened or eliminated the complication.

   ______________________________

   ______________________________

OBJECTIVE 31

## Assignment Sheet 3—Apply Electromagnetic Waveforms to Medicine

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, spelling and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

**INTRODUCTION** The physics associated with waveforms are regularly used in the surgical setting. Directing or controlling light waves and sound waves can prove useful for surgical tools.

**DIRECTIONS** Respond to each question or situation, then have your instructor evaluate.

1. You begin with a liquid or gas where there is no activity and then you create a waveform.

   a. How does the process of creating a waveform begin? Explain each stage of its movement.

b. How could you enlarge the displacement?

c. List two other factors like displacement to consider in evaluating a waveform.

2. You catch your friend dead asleep while sunbathing. There are already noticeable changes in the temperature and color of her exposed skin.

   a. Describe the significance of ozone and UVR on sunburn. Include mitigating factors. Classify each type of UV ray and its role in the progression from white to red or even blistered skin.

   b. Now argue for moderate exposure to UVB and give your reasoning.

3. You have been assigned to assist in analyzing an elderly patient with severe osteoporosis. It is uncertain whether there is bone breakage or a thinning of bone mass to the point of disintegration. Compare what your findings would be using ultrasound for this patient with a patient suffering from osteosarcoma, where there is a malignant tumor of the bone.

4. A child has been moved into the OR with severe heart palpitations. It is unclear if she struck her head on the pavement when she fell from the top of the jungle gym. She is having trouble breathing and her eyes are dilated. What non-invasive means should be used to assess the patient that will quickly provide information for intervention? How would this differ from what might be used to locate a small nail ingested by a toddler?

5. Compare and explain why you would choose ultraviolet radiation or X-rays or Continuous Wave Doppler for assessing a patient's vascular system.

6. List two good occupational safety strategies for regular exposure to X-ray irradiation.

OBJECTIVE 32

## Assignment Sheet 4—Research Lasers

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

- Directions were followed ______
- Questions were answered honestly ______
- Correct grammar, spelling, and punctuation were used ______

**Overall rating** ______

Evaluator's comments ______________________________

DIRECTIONS

Log on to http://www.colorado.edu/physics/2000/lasers/index.html. Review the material that pertains to lasers. Choose one of the following topics and write a short summary of it below: population inversion, exciting atoms with photons, and directing and focusing monochromatic light.

Population inversion

Exciting atoms with photons

Directing and focusing monochromatic light

**OBJECTIVE 33**

## Assignment Sheet 5—Visit a Hospital to View Radiation From Preparation to Disposal

Name ______________________________ Date ______________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, spelling, and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ____________________________________________

____________________________________________

____________________________________________

---

**DIRECTIONS** Visit the operating room and the health physics department at a local hospital.

**PART I** Ensure that your visit to the OR coincides with a surgery using the C-arm. Observe the procedures for preparing and using the C-arm. Write your observations in a short report below.

Preparation of C-arm

____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

Usage of C-arm

**PART II** Visit the health physics department and observe the handling and disposal of radioactive materials. Write your observations in a short report below.

Handling of radioactive materials

Disposal of radioactive materials

**OBJECTIVE 34**

## Assignment Sheet 6—Recognize the Implications of Using Nuclear Medicine

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, spelling and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

**INTRODUCTION** Nuclear medicine revolves around a basic understanding not only of matter, but of how matter responds to particular stimuli. This understanding influences the development of useful surgical tools and equipment. It must also shape how the surgical technologist approaches the patient, the surgeon and occupational safety.

**DIRECTIONS** Respond to each question or situation, then have your instructor evaluate.

1. A patient is having a carotid shunt inserted. Use of the fluoroscopic C-arm is necessary.

   a. Explain specific prep before surgery related to the C-arm. ______________

   b. Describe occupational safety procedures.

c. Which segment of the electromagnetic spectrum is being used?

2. Based on your visit to the health physics department of the hospital, answer the following questions.

   a. What methods did the hospital use to detect radioactivity?

   b. What precautions were taken in handling and disposing of radioisotopes?

3. Describe the two types of X-rays and their uses.

**OBJECTIVE 35**

## Job Sheet 1—Test Atmospheric Pressure

Name ______________________ Date ______________________

Attempt number ______________________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- Demonstration of experiment was successful ______

**Overall rating** ______

Evaluator's comments ______________________

---

**INSTRUCTIONS** Use the following method to demonstrate the existence of the atmosphere's pressure.

**TOOLS, EQUIPMENT, AND MATERIALS**

- Test tube
- Piece of paper

**PROCEDURE**

☐ 1. Fill a test tube with water until it overflows.

☐ 2. Place a piece of paper over the end and then turn the tube over.

☐ 3. Remove the paper SLOWLY and CAREFULLY.

☐ 4. Examine the test tube.

☐ 5. Explain your findings below.

1439

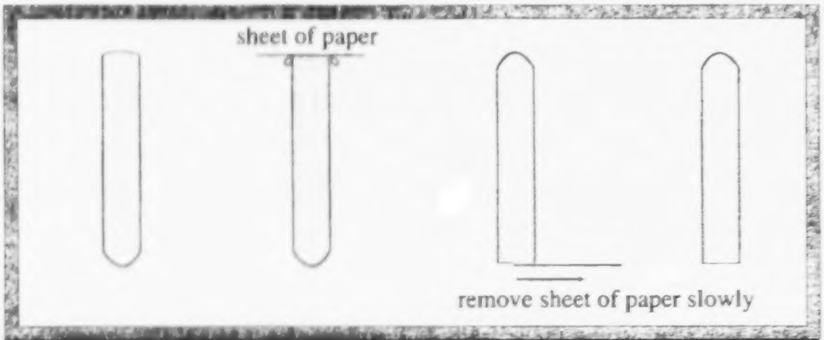
sheet of paper
remove sheet of paper slowly

Figure 1

Evaluator's Comments: ______________________________

______________________________

______________________________

**OBJECTIVE 36**

## Job Sheet 2—Create Waveform Polarization

Name ______________________ Date ______________________

Attempt number ________________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- Demonstration of experiment was successful ______

**Overall rating** ______

Evaluator's comments ______________________________________________

______________________________________________

______________________________________________

---

**INSTRUCTIONS**

After completing this job sheet, you should be able to determine how the propagation of waves are affected when channeled and how this can be related to laser technology.

**TOOLS, EQUIPMENT, AND MATERIALS**

- 2-6ft. woven ropes (not hard or rigid-must be pliable and substantial)
- 10x10 or 8x11 cardboard with 5x.5 inch slit cut down the center
- 6 participants

**PROCEDURE**

☐ 1. Break 6 participants into two teams of three.

☐ 2. Have one person from each team thread a rope through the slit until both sides are even.

☐ 3. Have that same person in Team 1 hold the card on a level surface so the slit goes up and down.

☐ 4. Have the same person in Team 2 hold the card on a level surface so the slit goes side to side.

☐ 5. Have the other four people each hold a rope end.

☐ 6. Let the person holding the rope on the left in each team begin moving the rope.

☐ 7. Have observers determine the sort of force it takes to create movement on the other side of the board.

☐ 8. Have observers compare movement when the slit is vertical vs. horizontal.

☐ 9. Have the team members move the rope slowly, and then stop.

☐ 10. Have observers watch how long the rope movement lasts.

☐ 11. Link this experiment to the polarization of light and laser beams.

☐ 12. Have the class document the data and their conclusions.

Evaluator's Comments: ______________________________

______________________________

______________________________

# Introduction to Surgical Technology

## SECTION E:
## Biomedical Science

### Module 4-E: Robotics

# Introduction to Surgical Technology
# Section E: Biomedical Science
# Module 4-E: Robotics

## Module Contents

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# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 4-E: Robotics

**PREREQUISITES:**
**None**

## Learning Activities Sheet

Student name ______________________________

**DIRECTIONS**

Place a checkmark in the appropriate box as you complete each of the steps below.

☐ 1. **Take** Pretest provided by your instructor.

☐ 2. **Stop** Have your instructor evaluate your performance.

☐ 3. **Read** Module Objective Sheet.

☐ 4. **Read** Student Supplement 1, "Minimally Invasive Surgery."

☐ 5. **Study** Information Sheet, Objectives 1 through 4.

☐ 6. **Do** Assignment Sheet 1, "Evaluate MIS Procedures."

☐ 7. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, return to step 4.

☐ 8. **Read** Student Supplement 2, "Medical Robotics."

☐ 9. **Study** Information Sheet, Objectives 5 through 12.

☐ 10. **Read** Student Supplement 3, "Robotic Design."

☐ 11. **Study** Information Sheet, Objectives 13 through 20.

☐ 12. **Do** Assignment Sheet 2, "Compare Surgical Robotic Equipment."

☐ 13. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 14. If the evaluation is not satisfactory, return to step 8.

www ☐ 14. **Research** Online resources to learn more about robotic equipment. Your instructor will add several recommended URLs below. Visit at least two.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

☐ 15. **Read** Student Supplement 4, "System Components."

☐ 16. **Study** Information Sheet, Objectives 21 through 27.

☐ 17. **Do** Assignment Sheet 3, "Identify Robotics Components."

☐ 18. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 19. If the evaluation is not satisfactory, return to step 15.

☐ 19. **Read** Student Supplement 5, "Robotic Motion."

☐ 20. **Observe** Demonstration of procedures to be used in completing Job Sheet 1.

☐ 21. **Do** Job Sheet 1, "Demonstrate Degrees of Freedom in the Human Arm."

☐ 22. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 23. If the evaluation is not satisfactory, study the procedure outlined in Job Sheet 1 and repeat step 21.

☐ 23. **Study** Information Sheet, Objectives 28 through 32.

☐ 24. **Do** Assignment Sheet 4, "Identify Robotic Motion."

☐ 25. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 26. If the evaluation is not satisfactory, return to step 23.

☐ 26. **Research** Online resources to learn more about robotic motion. Your instructor will add several recommended URLs below. Visit at least two.

• ____________________________________________

• ____________________________________________

• ____________________________________________

• ____________________________________________

• ____________________________________________

• ____________________________________________

• ____________________________________________

☐ 27. **Read** Student Supplement 6, "Robotic Control."

☐ 28. **Study** Information Sheet, Objectives 33 through 37.

☐ 29. **Read** Student Supplement 7, "Robotics in the Operating Suite."

☐ 30. **Study** Information Sheet, Objectives 38 through 43.

☐ 31. **Do** Assignment Sheet 5, "Explore Clinical Applications for Robotics."

☐ 32. **Stop** Have your instructor evaluate your performance. If evaluation is satisfactory, continue to step 33. If the evaluation is not satisfactory, return to step 30.

☐ 33. **Research** Online resources to learn more about robotics in OR. Your instructor will add several recommended URLs below. Visit at least two.

- 
- 
- 
- 
- 
- 
-

☐ 34. **Take** Written Test provided by your instructor.

☐ 35. **Stop** Have your instructor evaluate your performance. If the evaluation is satisfactory, continue to step 36. If the evaluation is not satisfactory, repeat steps 5, 9, 11, 16, 23, 28, and 30.

☐ 36. **Check** With your instructor for any additional assignments to be completed.

☐ 37. **Do** Additional assignments your instructor lists below.

☐ 38. **Take** Module Review provided by your instructor.

☐ 39. **Stop** Have your instructor evaluate your performance. Follow your instructor's recommendations concerning a review of the above learning activities.

☐ 40. **Stop** Have your instructor evaluate your performance on this module by compiling your scores on the assignment sheets, job sheet, Written Test, and Module Review. If the evaluation is satisfactory, proceed to the next module. If the evaluation is not satisfactory, ask your instructor for further instructions.

# Introduction to Surgical Technology
## Section E: Biomedical Science
## Module 4-E: Robotics

### Module Objective Sheet

**MODULE OBJECTIVE**

After completing this module, you should be able to describe the purpose of minimally invasive surgery. You should be able to identify the basic components and mechanisms of surgical robotic systems and the purpose of each, to apply the laws of motion to robotic movements, to describe pre-operative, inter-operative and post-operative use of robotics, and apply the principles of robotics you've learned to safe patient care practices. You should demonstrate these competencies by completing the assignment sheets and job sheet and by showing a minimum of 85 percent on the Written Test and on the Module Review.

**SPECIFIC OBJECTIVES**

After completing this module, you should be able to

1. Complete statements concerning the trend towards minimally invasive surgery.
2. List the four drawbacks of minimally invasive surgery.
3. Complete statements concerning surgical categories more easily adapted to MIS techniques.
4. List the fundamental impacts digital information has had on MIS technologies.
5. List the conditions which make the use of a robot instead of a human attractive.
6. Match the robotic characteristics that promote their use in surgical procedures to their correct descriptions.
7. Arrange in order the steps for integrating robotics into surgical procedures.
8. Describe the benefits of using robotics in MIS.
9. Identify the types of surgery where robotics can play a significant role.
10. List the pre-operative benefits of using robotics.
11. Complete statements concerning the inter-operative benefits of using robotics.
12. Select true statements concerning the post-operative benefits of using robotics.
13. Complete statements contrasting open incisions and MIS incisions.
14. Complete statements concerning key events in the invention of medical scope technology.
15. Match the two key scope types developed for endoscopic surgery since its advent in the late 1970's to their correct descriptions.
16. Select true statements concerning the difference in surgical stance when using flexible vs. rigid extenders.
17. List the primary issues in minimally invasive surgery.
18. Compare surgical technique in MIS with and without robotics.

19. Describe the four basic types of surgical robots.
20. Describe latency and its impact on telesurgery.
21. List the primary serial robotic components.
22. Identify each of the components in a telesurgical interaction.
23. Describe the functions of sensors and actuators.
24. Match sensor types to their correct descriptions.
25. Describe the function of the robotic components in the articulated mechanical system (AMS).
26. Match means of driving robotic arms to their correct descriptions.
27. Describe the sequence of events leading to robotic manipulation.
28. List the four basic types of movement.
29. Define *yaw*, *pitch*, and *roll*.
30. Match the degrees of freedom in the human arm to their correct motions.
31. Complete statements comparing degrees of freedom in a rigid endoscope and a flexible endoscope.
32. Complete statements concerning the degrees of freedom in the jointed medical robotic arm.
33. Complete statements concerning the four possible robotic control modes.
34. Identify components of robotic control.
35. List the options available for the user interface control and for monitoring surgical process.
36. List sensate options that should be available for an optimal haptics interface design.
37. Select true statements concerning the use of landmarks with robotics.
38. Identify each of the primary players during surgery.
39. List the four basic imaging tools used during an MIS procedure.
40. List the surgical tools potentially used during an MIS procedure.
41. Arrange in order the four basic preparatory steps for MIS or robotic procedures.
42. Arrange in order the steps to properly prepare and position robotic systems.
43. Complete statements concerning issues that must be addressed for integrating robotics into OR.
44. Evaluate MIS procedures. (Assignment Sheet 1)
45. Compare surgical robotics equipment. (Assignment Sheet 2)

46. Identify robotics components. (Assignment Sheet 3)
47. Identify robotic motion. (Assignment Sheet 4)
48. Explore clinical applications for robotics. (Assignment Sheet 5)
49. Demonstrate degrees of freedom in the human arm. (Job Sheet 1)

Introduction to Surgical Technology
Section E: Biomedical Science
Module 4-E: Robotics

## Information Sheet

**OBJECTIVE 1** **Complete statements concerning the trend towards *minimally invasive surgery*.**

KEY TERM

**Minimally Invasive Surgery (MIS)**—Access to the surgical site is through tiny incisions using specialized tools while minimizing damage to surrounding tissue. MIS falls somewhere between non-invasive procedures that don't violate the skin and open surgery, which requires incisions through the skin to access internal structures. Sometimes no incision is required, if a natural orifice can be used.

1. **Minimizes surgical stressors and negative effects on patient**
2. **Maximizes desired results related to surgery**
3. **Increases speed of recovery**
4. **Reduces complications**
5. **Increases productivity of hospital staff**
6. **Reduces long-term expense of surgery**

**OBJECTIVE 2** **List the four drawbacks of minimally invasive surgery.**

1. **May be more expensive and less effective, depending on the surgery**
2. **Loss of surgical freedom of movement**
3. **First-hand view of tissue is unavailable**
4. **Reliance on expensive equipment**

**OBJECTIVE 3** **Complete statements concerning surgical categories more easily adapted to MIS techniques.**

1. **Type of procedure**—Excisional and ablative procedures are more easily adapted to MIS techniques and robotic procedures in particular. Reconstructive procedures are less suited to robotics.
    - Excisional procedure—Involves removal of a structure
    - Ablative procedure—Involves removal of or destruction of tissue
    - Reconstructive procedure—Involves the joining or connection of structures

2. **Volume of procedure**—High volume vs. low volume procedures are more readily accepted as viable candidates for higher expense equipment, including robotics equipment, since the hospital is more likely to recoup the cost of the equipment in a smaller time frame.
   - High volume procedures—Lapcholy is an example, with 400,000/year in 1999
   - Low volume procedures—Congenital defect surgery is an example, with 25,000/year in 1999

OBJECTIVE 4 **List the fundamental impacts digital information has had on MIS technologies.**

1. **Digital data collection**
   - 2D or 3D scans of patient presented to the surgeon for review prior to, during and after surgery
   - Conversion of lab tests, patient history to digital format
2. **Digital manipulation**—Computer-aided review and navigation
   - Potential to review organ or tissue from multiple angles without damage to the patient
   - Multiple overlays to convey complex information to prepare surgeon and operating staff
   - Can be used to assist in surgical navigation
3. **Simulation**—The use of computerized models to simulate tissue and allow a surgeon to perform 'virtual surgery'
   - Tissue modeling
   - Catheter and needle synchronization
   - Surgical assistance
   - Surgical procedure
4. **Real-time relay of information**—Image-guided surgery provides internal surgical data not visible to surgical staff
5. **Micro-dexterity**
   - Introduction of technology to specific tasks that require a greater degree of precision than is humanly possible, such as neurosurgery, ophthalmology, and orthopedics
   - Sizing of instruments, sometimes to microscopic levels
6. **Scaling**—The ability to relay a movement by the surgeon at microscopic, and often adjustable, ratios (10:1, 20:1, 60:1, etc.) so that it is appropriate to the size of the surgical tool and the delicacy of the surgical procedure

7. **Teleconnections**

- Telesurgery—The surgeon is in direct control of the surgical robotic system, but that control is exerted from a distance
- Telecommunication—Data from the Internet and teleconferencing allows multiple surgeons to have input on a single surgery
- Telepresence—A surgeon who is not present at the site can participate in surgical procedures

OBJECTIVE 5

**List conditions which make the use of a *robot* instead of a human attractive.**

KEY TERM

**Robot**—A programmable manipulating machine that performs a specific task or series of tasks. A robot is comprised of a mechanical system of manipulators, links and joints that respond to a controller through mechanical or electrical means. This usually involves moving or handling objects or tools.

1. **Inhospitable or hazardous environments**—Extremely contagious diseases; mining accidents; military or war zones; radioactive material
2. **Minimal access; remote or microscopic environments**—Head and neck surgery; telesurgery; microsurgery
3. **Extremely demanding tasks that may incur high levels of fatigue**—Laparoscopic surgery; cardiovascular surgery; brain surgery
4. **Reduction of patient risk and enhancement of surgical precision (most often in conversion from open to minimally invasive surgery)**

OBJECTIVE 6

**Match robotic characteristics that promote their use in surgical procedures to their correct descriptions.**

1. **Precision**—Ability to limit movement to microns
2. **Patient safety**—Ability for less invasive, more accurate procedures, minimizing patient risk
3. **Reliability**—Ability to perform without illness or loss of concentration, early or lat without tiring
4. **Repeatability**—Ability to perform task again and again with precision
5. **Efficiency**—Responsive to surgeon's direction in performing routine tasks
6. **Miniaturization**—Sizing of tools down to microscopic levels
7. **Scaling**—Response to surgeon's movement by a greater than 10:1 ratio

OBJECTIVE 7 **Arrange in order the steps for integrating robotics into surgical procedures.**

✔ **NOTE:** Many new procedures are being created and existing procedures changed as more information and new technology becomes available. Nuclear physics, computerized modeling and even robotics can be seamlessly integrated for better patient outcome. This usually occurs in the following sequence:

1. **Scan to acquire patient-specific anatomical data**
2. **Separate into specific organs, structures and tissues**
3. **Build computer-aided 3D anatomical models**
4. **Perform model registration, either by external pins or by internal uniquenesses that will provide surgical guidance and navigation**
5. **Match *registration* to patient position**
6. **Establish image-guided tracking of surgical instruments relative to landmarks, tissue and organs**
7. **Perform surgery, either directly on the patient or from a distance**

KEY TERMS

**Computer-aided surgery (CAS)**—Surgical planning based on computer-generated 3D models of individual patient tissues, organs and structures

**Registration**—Metal pins or externally fixed objects that help "landmark" patient structures; sometimes internal anomalies can also be used to assist in surgical navigation

OBJECTIVE 8 **Describe the benefits of using robotics in MIS.**

1. **Converts open surgeries to MIS**
2. **Increases precision**—Allows at least 10x greater precision
3. **Improves dexterity**—Allows for managing smaller and smaller movements
4. **Allows for telesurgery**—Enlarges participation options
5. **Provides opportunity for virtual surgery**—For training, preparation
6. **Creates a telementoring environment**—Enables specialists to assist in long-distance learning or practice

OBJECTIVE 9 **Identify the types of surgery where robotics can play a significant role.**

1. **Optical surgery**
2. **Neurosurgery**

3. **Ear, nose and throat surgery**
4. **Cardiac surgery**
5. **Orthopedic surgery**
6. **Endoscopic surgery**
7. **Radiosurgery**

**OBJECTIVE 10** **List the pre-operative benefits of using robotics.**

1. **Data collection**—Imagery techniques (MRI, ultrasound, CT scanner, etc.); soft 3D modeling of anatomical structures detected with imagery assists in determining location of anomalies
2. **Interactive planning and feedback**
3. **Potential "dry-run" via simulation of both rigid and deformable entities**

**OBJECTIVE 11** **Complete statements concerning the inter-operative benefits of using robotics.**

1. **Precision**
    - Miniaturization—Smaller than human hands, more accurate
    - Movements can be set to microns instead of inches
    - Speed can be established and controlled exactly
    - Lack of tremor
    - Use of registration marks to act on a much finer scale with less error than humans can
2. **Access and dexterity**
    - Gauges minute changes in pressure, resistance through sensors
    - Manages tissue deflections
    - Provides less damaging or less invasive access
    - Offers new opportunities to access head and neck not possible without robotics or with greater potential of death
3. **Steady visual images by robotic camera vis-à-vis hand-held**

**OBJECTIVE 12**

**Select true statements concerning post-operative benefits of using robotics.**

✔ **NOTE:** Open procedures can require four to six weeks recovery time, while laparoscopic or MIS surgery requires less than one week for recovery.

1. **Improved outcome**
2. **Reduced complications**
3. **Review of surgery**
4. **Monitoring patient**

**OBJECTIVE 13**

**Complete statements contrasting open incisions and MIS incisions.**

1. **Keyhole or MIS incisions**
   - Typical number of incisions:
     - A single incision for the laparoscopic light source and for viewing
     - Two additional incisions for surgical tools after the trocar placement
   - Sometimes up to five trocars are placed, depending on the procedure.
   - Typical keyhole incision sizes include:
     - 5–30 mm for therapeutic procedures.
     - 2–10 mm for diagnostic procedures.
2. **Typical open surgery incisions**
   - Typical number of incisions: 1 to 3
   - Typical incision size: 10–40 cm for thoracic and abdominal cavity

**OBJECTIVE 14**

**Complete statements concerning key events in the invention of medical scope technology.**

1. **Introduction of the rod-lens set up, which increased light and thus heightened visibility by over 80 times**
2. **Development of *fiber optic cables* by a gastroenterologist**
3. **Direct visualization of the area**
4. **Angled lens *laparoscope* for multiple viewing angles**

KEY TERMS

**Fiber optic cable**—A cable that carries laser light from a source to a destination. The cable also can carry digital signals. It is made of thin fibers of glass or plastic and is very reliable as long as the cable is not bent too far, since this will break the fibers.

**Laparoscope**—A type of **endoscope** containing an optical and lighting system used for viewing internal abdominal tissue or cavity

**Endoscope**—A rigid or flexible tubular structure for access to and visualization of internal tissue through natural body openings or incisions

OBJECTIVE 15

**Match the two key scope types developed for endoscopic surgery since its advent in the late 1970's to their correct descriptions.**

1. **Rigid scopes**—A narrow, metal hollow tube used for viewing internal structures in the forward direction. The design of the scope can allow for straight on viewing or up to a 45-degree viewing angle. Occasionally the tubes are made of a rigid plastic.

   Examples: Electroscope; laparoscope; rigid video-endoscope

2. **Flexible scopes**—Tubing, normally of silicone-plastic, that shapes to various body contours to allow for multiple viewing angles

   Examples: Ultrasonic endoscope; fiber-endoscope (fiberscope); flexible video-endoscope; endo-periscope

OBJECTIVE 16

**Select true statements concerning the difference in surgical stance when using flexible vs. rigid extenders.**

1. **Rigid stem graspers**
   - Elbows remain about level with pectoral muscles in chest.
   - Tension from shoulders to elbows can produce rapid fatigue and tremor.
2. **Flexible stem graspers**
   - Elbows are free to drop to comfortable level.
   - Reduces fatigue.

OBJECTIVE 17

**List the primary issues in minimally invasive surgery.**

1. **Restricted access**—The surgeon cannot access the surgical site with hands or standard tools and is even restricted in how assistance is provided because the port of access is so small.
2. **Additional momentum**—The surgeon's movements are magnified, since the area of operation is smaller. As the magnification increases, the momentum increases exponentially.

3. **Restriction of movement**—The surgeon cannot move about freely. Since the incision is small, the surgeon must move only within the constrained zone of that tiny incision and the radius of movement beneath it, which is constrained by the trocars.

4. **Restricted or absent sensorial feedback**—Normal sensory data is not available

   - Visual data is restricted and may need to be augmented by computers or fluoroscopes
     - Absence of 3D vision of the surgical field
     - Restricted image of surgical field
     - Resolution may be limited by equipment
     - Inadequate contrast
     - Lack of true color
     - Video camera system lens angle may be less than ideal
     - Fiber optic lighting may not provide strong enough light
     - Anatomy surfaces are harder to detect
     - Difficulty finding "landmarks" that help the surgeon determine position
   - Touch available or augmented with **haptic** feedback systems
     - Poor dexterity
     - Reverse motion, since the pivoting of the tool around the handle is similar to paddling a canoe: if the tool should move right, the actual hand movement is to the left
     - Texture, temperature minimally available and only with equipment that has proper sensors
     - Applied force—Resistance, pressure, torque
   - Sound may not be available via microphone

5. **Awkward surgical stances**

6. **Potential for "sword fighting" of extenders, based on placement or positioning**

7. **Potential for puncture of blood vessels**

8. **Potential for injury to tissue**

9. **Potential for nerve damage**

10. **Potential for thermal injuries**

KEY TERM

**Haptic Interface**—The connection between the surgeon and operating tools that relays the sense of touch. Force, torque, pressure, shearing, vibration, sound and temperature can be sensed during open surgery. The haptic interface supplies as many of these same sensations as possible to the surgeon from the remote operation.

OBJECTIVE 18

**Compare surgical technique in MIS with and without robotics.**

1. **Typical endoscopic surgery**
    - Hand-held camera control
    - Minimal landmarks
    - Rigid or flexible stem graspers
        - Actuation of grasper
        - Axial rotation of head
        - Cutter, reamer, drill
        - Harmonic scalpel
        - Suturing and knot-tying with needle or graspers
        - Staple or clip applicator
    - Surgical stance is standing, often with arms tensed
2. **Minimally invasive surgical robots**
    - Guided robotic camera control
    - Registration, established landmarks
    - Potential end effector tools
        - Harmonic scalpel
        - Cutter, reamer, drill
        - Flexible stem graspers
        - Force reflecting graspers
        - Suturing and knot tying with needle or graspers
        - Staple or clip applicator
    - Telesurgical stance where surgeon is often seated at a console

**Objective 19**

**Describe the four basic types of surgical robots.**

1. **Computer-aided supervisory robots or dexterity-enhancing robots**
   - Used in the surgical suite to assist in navigation, enhance surgical accuracy or increase dexterity
   - Used to perform microsurgical tasks impossible to achieve by human hands alone

2. **Image-guided robots**—Used in the surgical suite to relay MIS internal information that is not readily visible as it would be during open surgery

3. **Tele-operative robots**—Used in the surgical suite via remote control, which can be in the same room or across an ocean

   ✔ **NOTE:** Telesurgical operations can involve multiple surgeons taking control of a single robotic device, though most frequently, the remote surgeon acts as mentor and not as an active surgeon. Tele-operative robots respond to commands from a control center and are not concerned with distance, other than any latency caused by that distance.

4. **Autonomous robots**—Perform specific tasks without human intervention

   ✔ **NOTE:** Most autonomous robots perform monotonous functions in assembly line fashion, which is not appropriate for surgical procedures.

**OBJECTIVE 20** **Describe latency and its impact on telesurgery.**

1. **Latency**—The delay as information is translated from surgeon to robot to patient tissue and then translated from patient tissue to robot to surgeon
2. **The speed of this translation is critical in making use of robotics. When there is significant delay (latency), it makes usage of the mechanism much less useful and more awkward.**

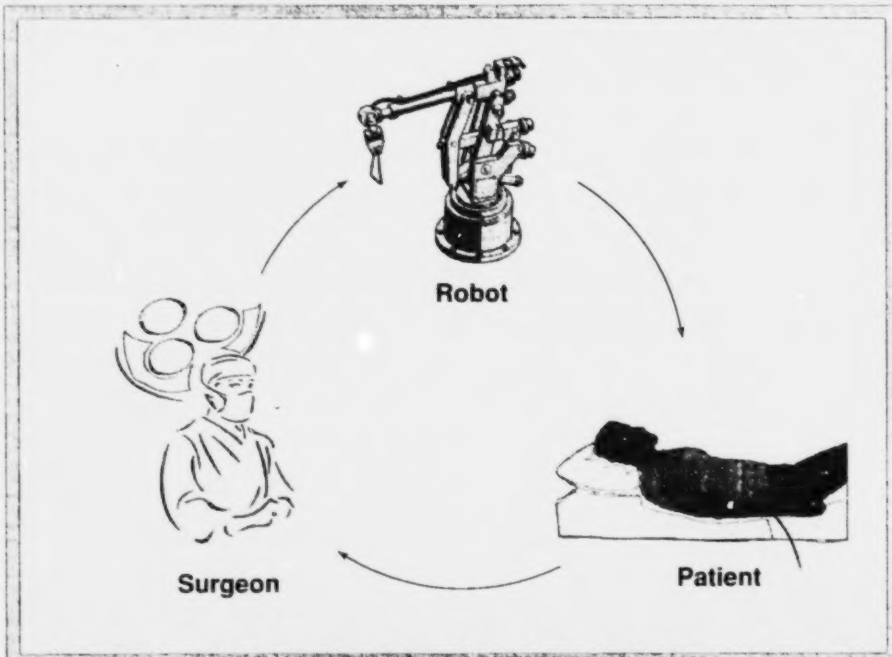

Figure 1
Latency

**Objective 21** **List the primary serial robotic components.**

1. **Power source**
2. **Operating console, user interface**
3. **Program and controller**
4. **Articulated mechanical system (AMS)**

Figure 2
Console

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**Objective 22** **Identify each of the components in a telesurgical interaction.**

1. **Surgeon and possible teleremote surgeon via modem and phone**
2. **Robotic control**
   - Pre-operative scans and 3D imaging
   - Input through user interface
   - Computer and program
3. **Actuators or activators**
   - Drivers
   - Amplifiers

4. **Robot or Articulated Mechanical System (AMS)**
    - Links
    - Joints
    - End-effector with instruments
5. **Encoders and sensors**
6. **Patient**

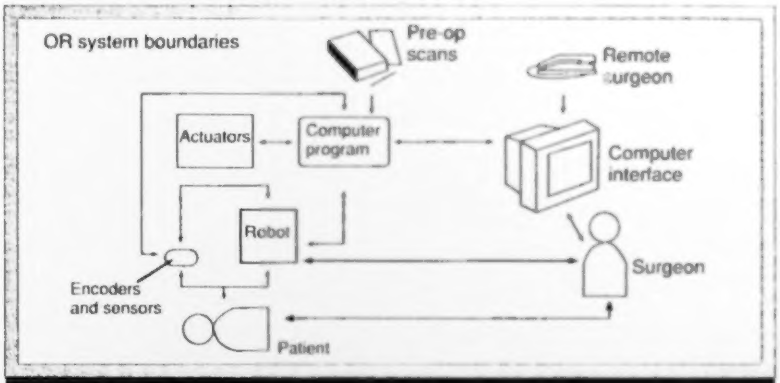
OR system boundaries
Pre-op scans
Remote surgeon
Actuators
Computer program
Computer interface
Robot
Surgeon
Encoders and sensors
Patient

**Figure 3**
**Telesurgical interaction**

**Objective 23** **Describe the functions of sensors and actuators.**

1. **Sensors**—Send signals about the state of the system and the operating field back to the controller
2. **Actuators**—Drive hardware that performs the requested task(s)

**Objective 24** **Match sensor types to their correct descriptions.**

1. **Tactile sensors**—Enhance and increase the sense of touch; this is a focus of researchers developing new microsensors
2. **Proximity sensors**—Determine how close the end-effector or tool is to the desired destination
3. **Thermal sensors**—Register temperature of surrounding area
4. **Visual sensors**—Interpret images and relay these to the controller; designed to create "robot vision"

    ✔ **NOTE:** Often, there is difficulty achieving *active visual sensing*, since the lag between processing and interpreting these images can exceed the real-time requirements that make such images useful.

OBJECTIVE 25

**Describe the robotic components in the articulated mechanical system (AMS).**

1. **Links**—Move based on prompting from drivers
   - Single arm, with joints at one or both ends

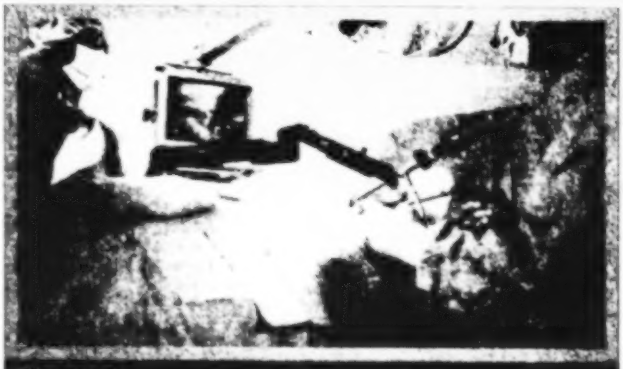

Figure 4
Example of single robotic arm, Aesop

Courtesy of Computer Motion, Inc.

   - Multiple arms

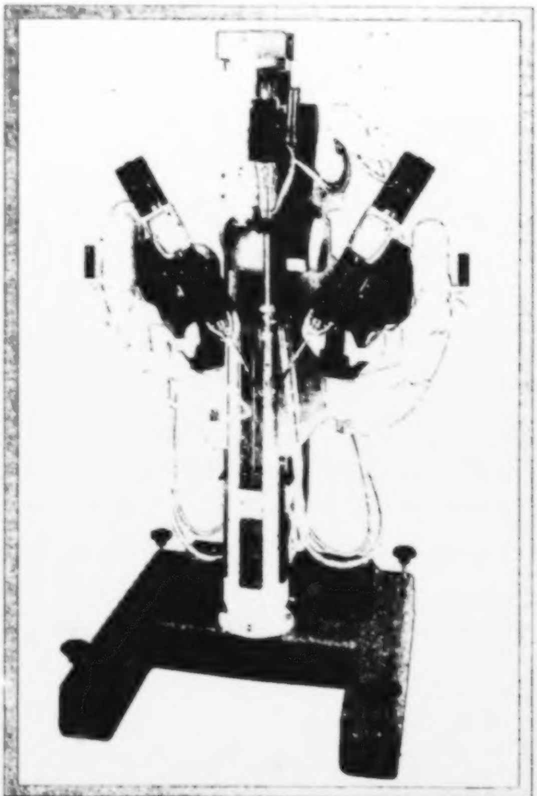

Figure 5
Example of multiple-arm robot, daVinci

©1999 Intuitive Surgical, Inc.

2. **Joints**—Each degree of freedom in the joint requires a sensor to measure its action

   - Prismatic axis (prismatic movement is denoted as 'P')

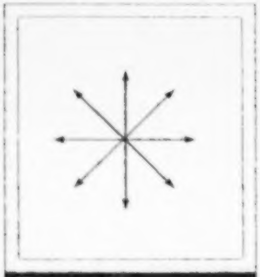

**Figure 6**
**Prismatic axis**

   - Rotary axis (revolute or rotational movement is denoted as 'R')

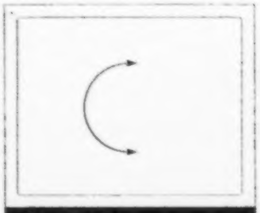

**Figure 7**
**Rotary axis**

3. **End effector, finger or fingers**—Each degree of freedom in the end-effector requires a sensor to measure its action

   - Point—Stylus, idealized finger
   - Two-point—Two fingertips for pinch grip
   - Instrument attachment

OBJECTIVE 26

**Match the means of driving robotic arms to their correct descriptions.**

1. **Mechanical systems**—Drive robotic arms through use of devices such as pulleys, gears, etc.

2. **Electrical systems**—Drive robotic arms by means of a servo system that translates electrical information into electrical or mechanical movements

OBJECTIVE 27

**Describe the sequence of events leading to robotic manipulation.**

1. **Positioning**—Used to get the robotic arm to a specific point in space. Three DOF are required to move to or return to a given point in space. The positioning mechanism of a serial robot is called the ***arm***.
2. **Orienting**—Used to turn or move the end-effector or tool so that it is prepared and properly aligned to perform a specific task. Three DOF are required to turn or move until a tool is properly aligned and prepared to perform a specific task. The orienting mechanism of a serial robot is called the ***wrist***.
3. **Manipulating objects**—Once the robot is positioned and oriented, the end-effector or tool can grasp, move, lift, turn a given object or perform its specified task. This task is performed by the ***end effector***.

KEY TERMS

**Arm**—The portion of a robot that performs basic positioning movements by means of a series of joints, links and drivers

**Wrist**—The portion of a robot that performs basic orienting movements by turning (revolving) around a fixed pivot point

**End effector**—The portion of a robot that performs a specified task, often involving grasping or moving objects

OBJECTIVE 28

**List the four basic types of movement.**

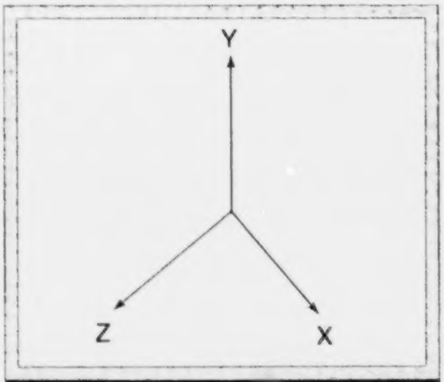

**Figure 8**
**Types of movement**

1. **Up and down (Y-axis)**
2. **Left and right (X-axis)**
3. **In and out (Z-axis)**
4. **Open and closed (end-effector)**

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**OBJECTIVE 29** **Define *yaw*, *pitch*, and *roll*.**

1. **Yaw**—Rotational and prismatic motion that moves left to right
2. **Pitch**—Rotational and prismatic motion that moves up or down
3. **Roll**—Rotational motion

**OBJECTIVE 30** **Match each degree of freedom in the human arm to its motion.**

✔ **NOTE:** The human arm has 7 basic DOF—3 in the shoulder, 1 at the elbow and 3 at the wrist. If the hand is included, there can be as many as 24 DOF.

1. **Pivot shoulder up/down**—Pitch
2. **Pivot shoulder left/right**—Yaw
3. **Rotate shoulder**—Roll
4. **Pivot elbow up/down**—Pitch
5. **Pivot wrist up/down**—Pitch
6. **Pivot wrist left/right**—Yaw
7. **Rotate wrist**—Roll
8. **Hand adds much more complexity**—Each finger and the thumb have multiple DOF

**OBJECTIVE 31** **Complete statements comparing degrees of freedom in a rigid endoscope and a flexible endoscope.**

✔ **NOTE:** Endoscopic degrees of freedom will vary, based on whether they are rigid (fixed) or flexible.

1. **Basic rigid (fixed) endoscopes have four DOF.**
2. **Flexible endoscopes can have between five and six DOF.**

**OBJECTIVE 32** **Complete statements concerning the degrees of freedom in the jointed medical robotic arm.**

✔ **NOTE:** Robotic arms can vary. The example artwork located in this objective is of an industrial robot not of a medical robot, so the axes will not match identically those listed but will illustrate the point. To be able to get to any point within the robot's reach, it must have the basic 6 degrees of freedom: 3 arm movements and 3 wrist movements. The end-effector is listed here, as well, but is not considered part of the robotic arm per se. Robotic components for a jointed, articulated arm with the basic 6 DOF are as follows:

1. **Rotate waist or shoulder**—Roll
2. **Pivot shoulder left/right**—Yaw
3. **Pivot elbow up/down**—Pitch

4. **Pivot wrist up/down**—Pitch
5. **Pivot wrist left/right**—Yaw
6. **Rotate wrist**—Roll
7. **End-effector grasp**—Open/close is not included because the end-effector can be highly specialized and quite complex or contain an extremely simple tool

✔ **NOTE:** Robotic complexity also varies.

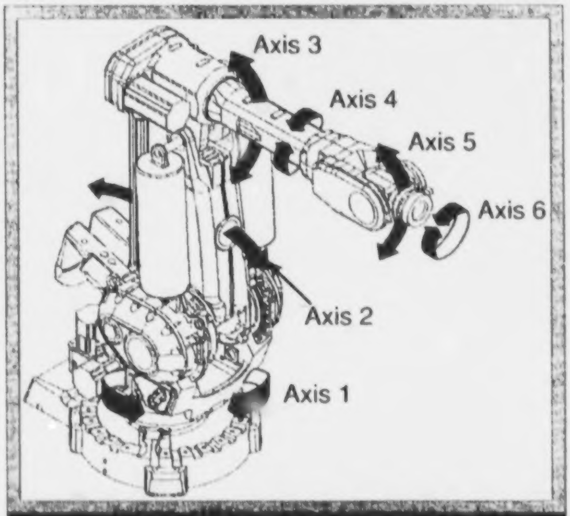

Figure 9
Robotic motion for an industrial robotic arm

Illustration reprinted with permission of ABB Inc.

OBJECTIVE 33 **Complete statements concerning the four possible robotic control modes.**

1. **Manual mode**—Actuators and amplifiers are disabled, so that the surgeon can move the robotic arm (AMS) to the desired location. However, encoders and sensors remain active to register manual motion and relay positional information to the program.
   - Tool motion manually activated by the surgeon
   - Allows surgeon to double-check robotic programming
   - Allows surgeon to perform tasks that are not programmed into computer controller
   - Allows for programming a new procedure into computer control memory
   - Allows surgeon to program specific segments of the procedure
2. **Collaborative mode**—The surgeon must notify the program of an override
   - Allows for total override of the robotic system for a segment of the procedure
   - Allows the robotic system to function autonomously for another segment

3. **Shared control**—Similar to collaborative control, but the surgeon specifies a particular action that is a deviation from a specified path
    - Movement is allowed only on one axis
    - Robot maintains control of the other axis
4. **Autonomous control**—The surgeon specifies a beginning and end point and the robotic system computes the course of action and performs the task without further intervention
    - Useful in manufacturing environments
    - Not seen as applicable in the surgical arena

**OBJECTIVE 34**

**Identify components of robotic control.**

Hardware and software for managing robotic functions are integral to controlling the robot, functioning as its brain. In order to control systems from within the sterile field, equipment must be carefully placed and the heart of robotic control, the computer system, should be in an adjacent room. The user interface may be controlled by voice, by eye or by joystick, sterilizable mouse or keyboard.

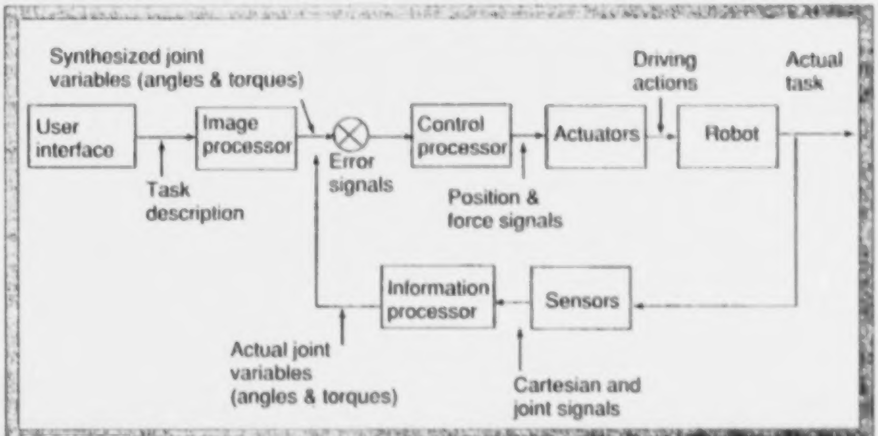
Synthesized joint variables (angles & torques)
Driving actions
Actual task
User interface
Image processor
Control processor
Actuators
Robot
Task description
Error signals
Position & force signals
Information processor
Sensors
Actual joint variables (angles & torques)
Cartesian and joint signals

Figure 10
Components of robotic control

1. **User interface**
2. **Processors**
    - Imaging processor
    - Control processor
    - Information processor

3. **Actuators and sensors**
   - Actuators
   - Sensors
4. **Robot (AMS)**

OBJECTIVE 35

**List the options available for the user interface control and for monitoring surgical process.**

1. **User interface**—Varies, depending on type or function of robotics subsystem
   - Voice control systems
   - Joystick, keyboard, mouse
   - Eye or head movement control systems
   - Haptic interface, usually teleoperated

   ✔ **NOTE:** The use of the senses is not to be underestimated in surgery. As the progression to minimally invasive surgeries continues, there is a significant increase in isolation and distance from the actual operation. A haptic interface tracks hand movements and relays these to the controller and on to the robotics.

2. **Visualization systems**—More information is being constructed through non-invasive means. These computer-generated images are then overlaid with real-time images to assist the surgeon. Visualization systems can be tricky, like looking in a mirror. The movement of the tool may be opposite of the direction in which the surgeon moves.
   - 3D—Either head-mounted gear or a remote monitor (telemanipulation)
   - 2D—In the 90's, it was 2D and difficult to tie knots in particular. This is more easily performed with 3D imaging.

**OBJECTIVE 36** **List sensate options that should be available for an optimal haptics interface design.**

✔ **NOTE:** Haptic interfaces provide a modified sense of touch, since the surgeon doesn't have the feedback open surgery would provide.

Figure 11
Haptic interface

Courtesy of Intuitive Surgical, Inc.

1. **Force**
2. **Pressure**
3. **Resistance**
4. **Shearing**
5. **Weight**
6. **Torque**
7. **Texture**
8. **Temperature**
9. **Vibration**

**OBJECTIVE 37**

**Select true statements concerning the use of landmarks with robotics.**

Frames of reference or landmarks serve to:

1. **Designate coordinates for robotic movement to specific locations**
2. **Specify relationships between landmarks and structures**
3. **Assist in surgical navigation**

**OBJECTIVE 38**

**Identify each of the primary players during surgery.**

✔ **NOTE:** This particular diagram is from a da Vinci unit, but the layout is very typical for robotic system interactions in general.

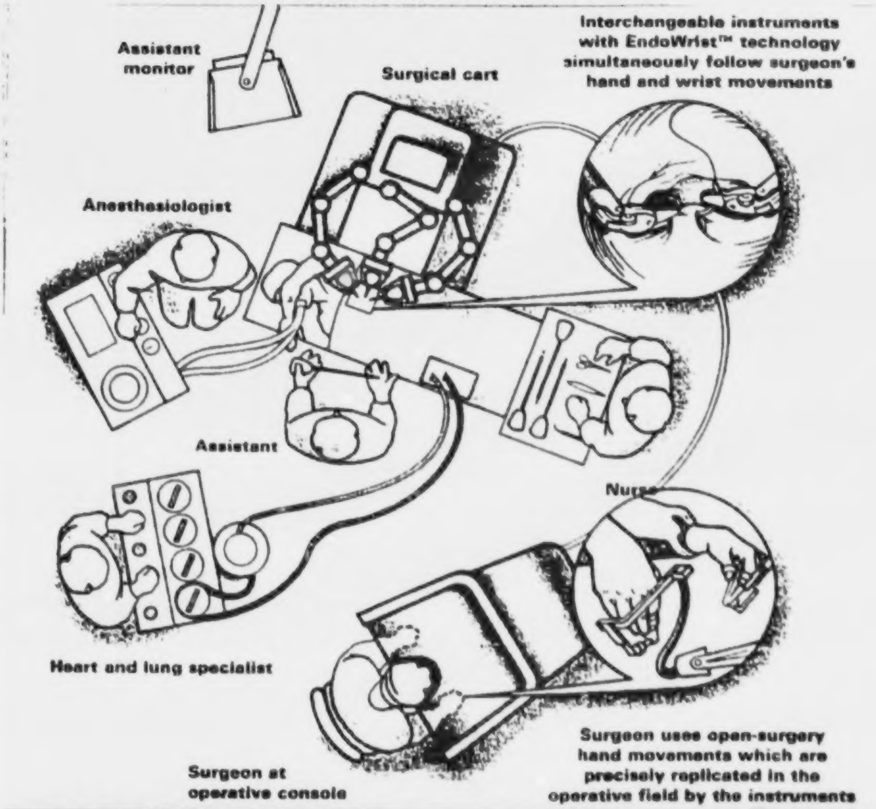
Assistant monitor
Surgical cart
Interchangeable instruments with EndoWrist™ technology simultaneously follow surgeon's hand and wrist movements
Anesthesiologist
Assistant
Nurse
Heart and lung specialist
Surgeon at operative console
Surgeon uses open-surgery hand movements which are precisely replicated in the operative field by the instruments

Figure 12
da Vinci Surgical System

©1999 Intuitive Surgical, Inc.

**OBJECTIVE 39**

**List the four basic imaging tools used during an MIS procedure.**

1. **Endoscope**
2. **Light source**
3. **Camera or video system**
4. **High resolution monitor**

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**OBJECTIVE 40** **List the surgical tools potentially used during an MIS procedure.**

1. Coagulator
2. Dissection tools
3. Electrocautery tools
4. Extenders
5. Harmonic scalpel
6. Holding or moving tools
7. Irrigation and aspiration tools
8. Insufflation tools
9. Laparoscopic ultrasound wand
10. Laser tools for cautery, coagulation, and vaporization
11. Ligation tools
12. Retraction tools
13. Suturing and knot-tying tools
14. Stapling or clipping tools

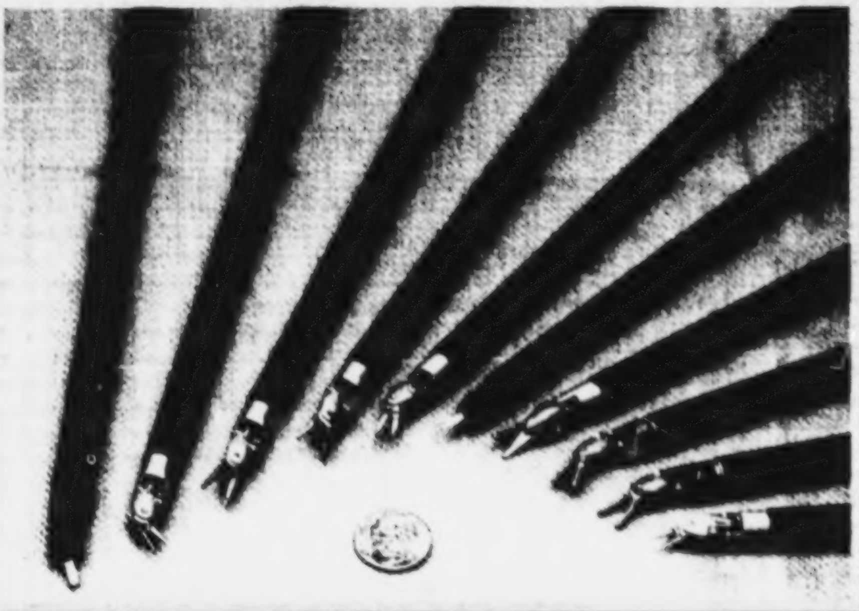

Figure 13
Example of MIS robotic tools

Courtesy of Intuitive Surgical, Inc.

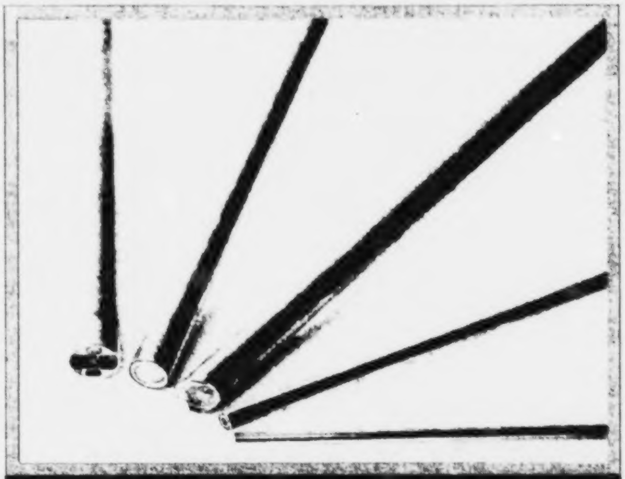

Figure 14
Example of endoscopic robotic tools

Courtesy of Computer Motion, Inc.

**OBJECTIVE 41** **Arrange in order the four basic preparatory steps for MIS or robotic procedures.**

1. **Position equipment**
2. **Position and set up operating table**
3. **Drape equipment**
4. **Position patient**

**OBJECTIVE 42** **Arrange in order the steps to properly prepare and position robotic systems.**

1. **Collect materials and check robotics equipment prior to establishing the sterile field.**
   - Surgical console
   - Video tower
   - Robotic tray
     - Robotic system control unit
     - Cables and miscellaneous accessories
     - System drapes
     - Sterilization tray with sterile robotic components
     - Hand control

  - Voice card (if robotics respond to voice commands)
  - Check for additional accessories, such as surgical microphones or 3-D polarization glasses
- Robotic arm(s)
  - Cable up the system, connecting all pertinent cables to appropriate systems
  - Ensure foot pedals, hand controls or voice control systems are positioned and connected
  - Power up systems
  - Complete 'boot' process and ensure all systems are functional
- Position systems.

  ✔ **NOTE:** Most manufacturers assume this process occurs prior to creating a sterile field.
- Move cart carrying robotics to OR table.
- Position robotic arm(s).

  ✔ **NOTE:** Verify optimal positioning in surgical protocol guide provided with unit.
  - Position the robotic equipment to the OR table rail.
  - Adjust height of the positioning arm(s).
  - Position along the length of the OR table rail to fit patient and procedure.
  - Re-adjust height of the positioning arm(s) or tilt as necessary.
  - Attach instrument arm(s).

2. **Establish sterile field.**

- Drape robotic arm(s) and hand control using aseptic technique and cinching them tight with provided tape.
- Attach instrument collars from sterilization tray.
- Attach sterile instruments.

OBJECTIVE 43

**Complete statements concerning issues that must be addressed for integrating robotics into OR.**

1. **Space**—Clear the space. Too many cables and too much equipment makes for difficult logistics. Ceiling mount or get into special room as much of equipment as possible, so that OR is clear.

2. **Preparation time**—Set up times need to be shortened. Some of this is accomplished by becoming used to new procedures, but some requires a rethink of draping and sterilization techniques and sheer volume of equipment.

3. **Equipment**—Equipment ergonomics should mandate a different approach to monitor setup, table placement, etc.

4. **OR specialized rooms**—Dedicated space for robotic and videoscopic surgery.

## Student Supplement 1—Minimally Invasive Surgery

### INTRODUCTION

The advent of miniature cameras and fiber optics revolutionized medicine. What began as a breakthrough in 1987 for the laparoscopic cholecystectomy has spread beyond abdominal surgery. Laparoscopic surgery has rapidly become a defined series of specific surgical procedures designed to minimize impact on patients. In fact, there are specific endoscopic applications for virtually every part of the body, from video-assisted surgery to surgery performed with robotics.

### MINIMALLY INVASIVE SURGERY (MIS)

The most critical difference between MIS and open surgery is not simply the minimal size of the incision; it is in the implications: radical changes to tissue or structure access and added complexity to procedures. There are significant constraints based on what can be seen at a given moment, what can be reached, what can be "touched" or felt. In fact, endoscopic surgery requires the surgeon to coordinate actions with no longer physically visible tools using a visual image projected on a monitor across the surgical field. In addition to the restricted movement and a reduction in tactile feedback, the magnification of the site requires the surgeon to slow surgical movement. If the camera is placed from the opposite vector of the endoscopic tools performing the surgery, the video image is reversed in a mirror image of what the surgeon is actually doing, dramatically impacting surgical precision and speed. However, despite the increased complexities of performing MIS, the benefits to the patient are quite often significant.

### COMPUTER-AIDED SURGICAL PLANNING (CASP)

Using MRI and CT scans or other pre-operative images, surgeons can preview 3D computer data and map out a sensible surgical plan. In fact, presurgical simulations are possible. Several companies provide a whole computerized system that can be utilized pre-operatively, during the operation and post-operatively, as well.

### MINIMALLY INVASIVE IMAGING

There are many new capabilities emerging in the medical field, and some of them are in handling images of internal patient structures. Functional imaging and spectroscopy have become very useful when real-time data related to surgical status is required. 3D blood flow and heart wall motion imaging is regularly integrated into cardiac procedures. Nuclear medicine has provided additional tools as well:

- Multi-head nuclear cameras and detecting systems
- Faster counters (half-life isotopes)
- Lower radiations can accomplish the same effect
- Tools for locating multiple metastasis

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**MINIMALLY INVASIVE BIOCHEMICAL SENSORS**

Trends in this area will continue to change, since this is a very new and rapidly changing area of research and development. Plans are to use microbiosensors in combination with microrobotics to travel in the blood stream. It is hoped that they will be able to detect, repair or dissect tissues or structures as soon as anomalies are discovered. Examples include measuring odors and smells and measuring perspiration and urine.

KEY TERM

**Biosensors**—Sensors that trigger on two different levels: 1) biological component that responds to chemical compounds and 2) physical components that convert that reaction into a signal that is registered on external specialized equipment.

## Student Supplement 2—Medical Robotics

**MEDICAL ROBOTICS TECHNOLOGY**

Industrial robots have been employed in a variety of environments since the 1970's. Acceptance into the medical market has been slower, first really coming into its own in the late 1980's. The surgical environment has very high aseptic standards and many surgeons are reluctant to rely on equipment that may be susceptible to electrical interference, power failure or glitches in programming. These disadvantages are being whittled back over time and some strong advantages are coming to the fore. The development of robots that are highly robust, extremely accurate and that also meet patient and occupational safety standards is a challenge being met by companies as close as California or as far-flung as Japan.

Medical robots range from very simple to fairly complex. Some are fairly static, with a minimum of moving parts, while others can perform specialized functions that are not achievable by humans. For robotics to be integrated into the operating room, they must serve a key function that is difficult or virtually impossible with standard open procedures, as well as provide precise and specialized functions that are easy to use. They must be reliable and sterile. They must return the patient to care with minimal trauma to the body. To that end, robotics should be used only when they can assist in speeding recovery, reduce surgical cost and minimize pain and tissue damage.

### Why A Robot?

**EXTERNAL CONDITIONS**

- Inhospitable or hazardous environment
- Minimal access, remote or microscopic environment
- Tasks that are extremely demanding or incur high levels of fatigue
- Tasks that will reduce patient risk and raise surgical precision (most often conversion from open to minimally invasive surgery)

**ROBOTIC CHARACTERISTICS**

- Precision—Human: 1mm accuracy, robotics: >10μm (10x greater)
- Patient safety— Less invasive, more accurate
- Reliability—Can work just as well at midnight as 8:00 am and does not tire
- Repeatability—Can perform the same task with the same accuracy over and over again
- Efficiency—Can function with little wasted motion, depending on control options
- Size or miniaturization—Less invasive, more accurate than open procedures
- Intuitive feedback—More realistic sensory information through senses than from laparoscopy
- Scaling—Can take a surgeon's movement and reduce it by an order of magnitude

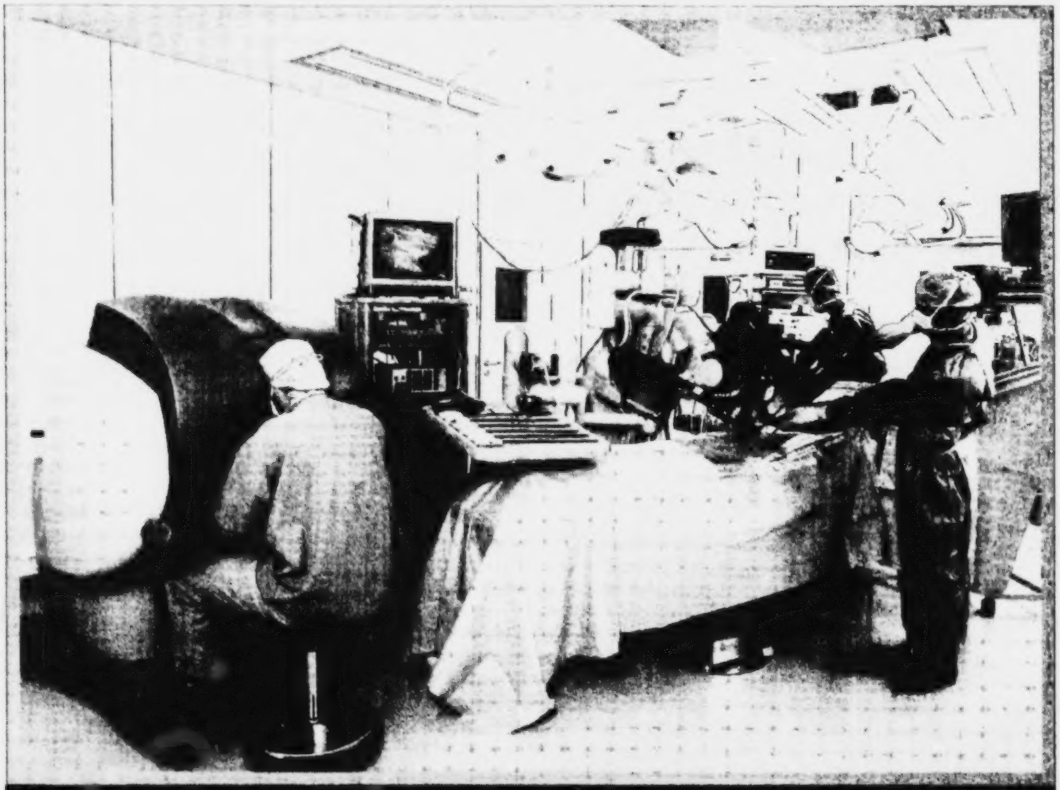


**Figure 1**
**Robotics in use in OR**

©1999 Intuitive Surgical, Inc.

## Student Supplement 3—Robotic Design

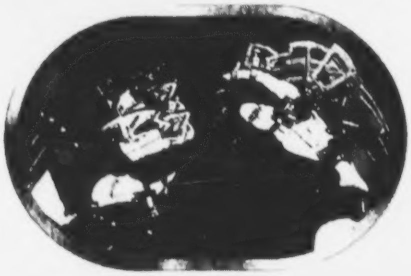
### ROBOTIC DESIGN CONSIDERATIONS

Medical robotics must adhere to a much more exacting standard than industrial robotics, since maintaining a sterile field and ease of integration into the OR suite are extremely important. There are many more features that must be considered as well. Critical elements in the robotic design are:

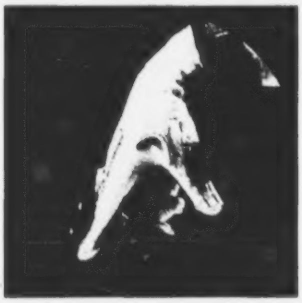
- Intuitive interface—Ensure surgeon can comfortably run equipment with as little learning curve as possible
- Velocity controlled, reduced latency—Mechanical speed drops as the precision increases, delay between the time of the command and the time the robot responds needs to be minimal
- Flexibility of tool set—Robotics need to be able to handle various surgical tools with ease
- Unit must be draped and aseptic—Sterility of the surgical field must be maintained
- Ease of use—Surgical team must be able to work with and around the unit
- Simplicity—System should be streamlined to minimize cables, connections, etc.
- Compatibility with existing procedures—Consistent with current practice and procedure
- Flexibility—Usage with variety of patient ages and types
- Modular—Allow for flexibility in use and application
- Ease of integration—Compact footprint, potential to ceiling mount unit
- Strong upgrade path—Easily incorporate new changes as they become available
- Backup plan—Redundancy and ease of interception during potential unit failure

### Haptics

The use of the senses is not to be underestimated in surgery. As the progression to minimally invasive surgeries continues, there is a significant increase in isolation and distance from the actual operation. More information is being constructed through non-invasive means and then overlaid on top of the real-time images to assist with visual data. Some robotic designs incorporate microphones so that real-time sound is relayed back to the surgeon. Still others have invested significant energies in haptic designs where the surgeon holds the same instruments the robot is holding and receives tactile feedback from the surgical site.



CyberTouch™ provides vibrotactile stimulators on each finger and the palm of the hand.



CyberGrasp™ provides resistive force feedback for the hand from dc motors.

Figure 1
Haptic interfaces

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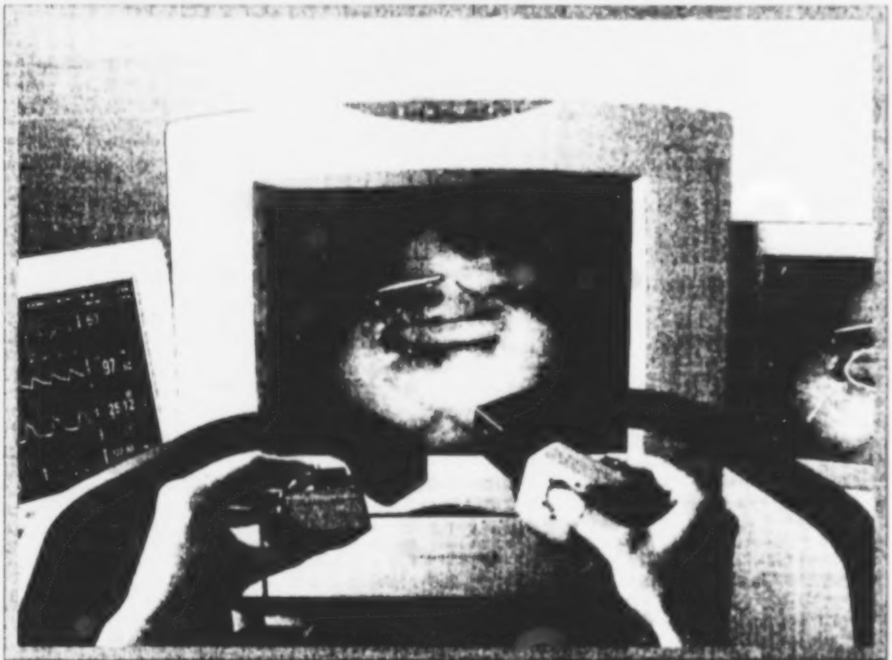

Figure 2
Haptic and user interface in use

Courtesy of Computer Motion, Inc.

**LATENCY**

The issue of latency has also been addressed to minimize the time it takes between the robotic movements and when the surgeon feels that movement remotely and vice versa. Some systems are more responsive than others.

**REGISTRATION**

Robot systems often require a registration system, some sort of specified physical or logical landmark. In such instances, a pre-operative scan of tissue and structure is needed. Familiarity with the imaging software that displays robotic orientation and activity is also necessary.

Incorporating new technology into existing procedures usually occurs on an incremental level. Robotics can be of assistance in the surgical suite in several ways. Some are passive and require manual manipulation. The majority of robotic units used in the OR suite fall into this category. Their purpose is usually to hold equipment or tissue. Other robotic units are more active and can respond to commands from the surgeon or assistant, either by means of hand or foot pedals, a haptic unit that emulates the human hand, keyboard instructions through a computer program, or via voice actuation. Some are even capable of operating autonomously. Robotic complexity is dictated by the task it is designed to perform. Most surgical robots can perform complex motions that mimic the human waist, shoulder, arm, wrist and hand, which allows for the greatest level of freedom to serve the same functions those human components would.

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### Surgical Robotic Complexity

The complexity of surgical robotics is driven by several factors:

- Task—The complexity or simplicity of the surgical procedure to be undertaken
- Access—The complexity or simplicity of gaining access to the surgical site
- Ease of use—The ease with which the surgeon can operate the equipment

Unlike human beings, robots can be repetitively precise, relatively free of fatigue and reasonably quick during the actual activity for which they've been designed. Uranüs et al. (2002) found that surgeons who have been exposed to laparoscopic surgery adjust quickly, but caution that surgeons used to open procedures will have a much more difficult time transitioning. This can be extrapolated to staff in OR. There is a steep learning curve in draping robots and many have found that preparation time is initially much longer and more complex than might be expected, though reduced over time. Broeders and van der Werken (2002) found robotics add to the chaos in the operating room; too much equipment and cables in cramped quarters. Often this is because of the fixed operating table and keeping all equipment in the room instead of an adjacent equipment room.

## Surgical Robotic Systems

### Single Function Robotics

- **AESOP**—Automated Endoscope Systems for Optimal Positioning (Computer Motion Inc.)

  A robotic arm for endoscopic positioning. Surgeon controls camera position by voice or hand control or by foot pedal. Can be used in conjunction with Zeus and Hermes to make a complete robotics system.

- **APD**—Automated Pharmaceutical Dispenser (Advanced Manufacturing and Mechatronics Centre)

  A robotic dispenser that prepares, dilutes and measures patient preparations of radioisotopes used in nuclear imaging. While this is not directly a surgical robot, its impact in pre-operative diagnosis is not to be underestimated.

- **CASPAR**—**C**omputer **A**ssisted **S**urgical **P**lanning **A**nd **R**obotics (OrtoMAQUET)

  A robotic surgical tool for bone drilling and endoprosthetic placement. Based on industrial chip fabrication robotics. Extremely precise (0.5 to 0.8 mm) bore. Utilizes CT scans for 3D planning. Consists of the robotic arm, milling tool and calibration unit.

- **Crobot**—(CIMIL)

  A robotic colonoscope

- **EndoAssist**—(Armstrong Health Care)

  A robotic arm for holding an endoscopic camera. Moves in unison with the movement of the surgeon's headband sensor.

- **Evolution I**—(Universal Robot Systems)

  A robotic surgical tool for bone drilling and endoprosthetic placement; 6 DOF robot based on astronomy robotics with 10-μm precision

- **FIPS**—(Karl Storz)

  A robotic arm for holding an endoscopic camera

- **MKM**—(Carl Zeiss)

  A robotic arm for holding a neurosurgical microscope; foot, hand, mouth or voice can position it

- **RoboDoc**—(Integrated Surgical Systems)

  A robotic surgical tool used to core bone shafts and for endoprosthetic placement

- **Urobot**—(CIMIL)

  A robotic system for urological disorder surgeries

**MULTIFUNCTIONAL ROBOTICS**

- **ARTEMIS**—Advanced Robot and Telemanipulation System for Minimally Invasive Surgery (Forschungszentrum Karlsruhe)

  A robotic system for endoscopic positioning and guiding instruments in laparoscopic surgery. Comprised of a man-machine interface (MMI), an endoscope and two robotic arms.

- **da Vinci**—(Intuitive Surgical)

  Currently, Intuitive Surgical develops some of the only 7 DOF surgical robotics systems. This robotic system consists of three arms and a master console for guiding instruments in endoscopic surgery. The two-channel endoscope allows for two independent, binocular images that are merged to allow the surgeon a larger cone of vision. Robot operates with a pulley system. While it was initially developed to target cardiac surgical procedures, it can also be used in gastro-intestinal, gynecological and urological procedures. Over 1,000 surgeries have been completed with the units with over 50 systems worldwide.

- **LARS**—(Johns Hopkins, IBM) Still in development.

  A robotic system for endoscopic positioning and guiding instruments in laparoscopic surgery

- **MINERVA**—(EPFL) Still in development.

  A stereotactic robotic system for guiding instruments in neurosurgery

- **NeuroMate**—(Integrated Surgical Systems)

  A robotic system for guiding instruments in stereotactic brain surgery

- **PUMA**—(Westinghouse Electric)

  The PUMA 560 robotic system was used for transurethral prostate resection in 1991.

- **RAMS**—Robotic-Assisted MicroSurgery (MicroDexterity Systems, Jet Propulsion Lab) Still in development

  A 6 DOF robotic system for guiding instruments in extremely delicate surgeries; these include surgery on the brain, eye, ear, heart and spine

- **Zeus**—(Computer Motion)

  A 6 DOF robotic system for guiding instruments in laparoscopic and cardiac surgery. Comprised of the Hermes control center, AESOP endoscopic arm and two manipulator arms for instruments. The surgeon's movements can be scaled for great precision of electronically controlled instrument arm movement. Surgeon tremor is filtered out electronically. Zeus can be used in abdominal and cardiac surgeries.

### EXAMPLES OF SURGICAL ROBOTICS SYSTEMS

- Most surgical robots perform on six to seven degrees of freedom, but some function on less.
- The complexity of the task will determine the complexity of the robotic system and robotic control.
- Robotic tools can also be simple to complex, depending on intended use.

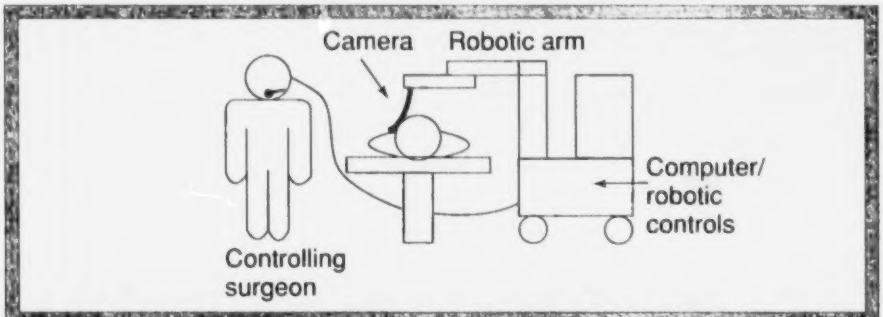

Camera
Robotic arm
Computer/
robotic
controls
Controlling
surgeon

**Figure 3—AESOP system**

A surgeon controls the position of the camera via voice or hand, while at the same time operating on the patient.

From J.G. Webster (ed.), *Minimally Invasive Medical Technology.* Institute of Physics Publishing, Bristol UK, 2001.

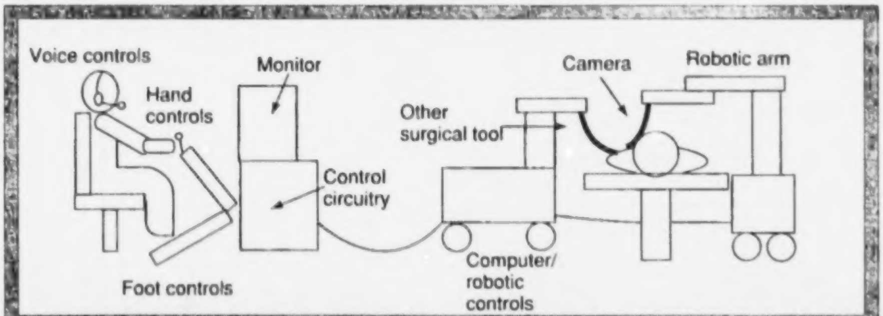

Voice controls
Hand
controls
Monitor
Camera
Robotic arm
Other
surgical tool
Control
circuitry
Foot controls
Computer/
robotic
controls

**Figure 4—Zeus robotic system**

The surgeon controls everything from a remote operating station. One of the robots holds a camera while the other holds a surgical tool to perform an operation.

From J.G. Webster (ed.), *Minimally Invasive Medical Technology.* Institute of Physics Publishing, Bristol UK, 2001.

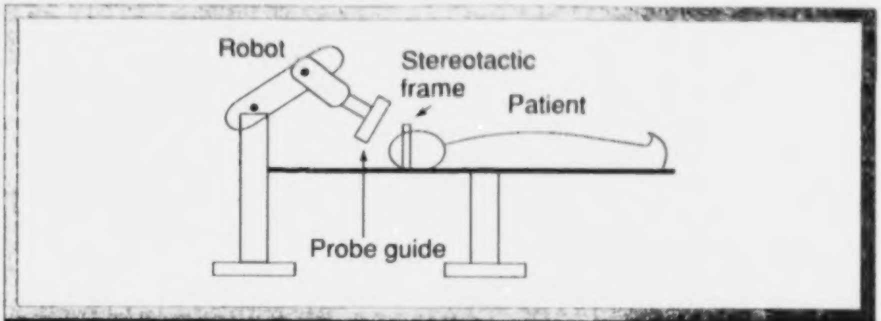

Robot
Stereotactic frame
Patient
Probe guide

**Figure 5—PUMA robot**

The robot is controlled by a computer and uses the information gained from the CT, or other type of imaging modalities, to find the optimal position of the probe guide.

From J.G. Webster (ed.), *Minimally Invasive Medical Technology.* Institute of Physics Publishing, Bristol UK, 2001.

**EXAMPLES OF ENDOSCOPES**

- Rigid scopes
  - Electroscope
  - Laparoscope
  - Rigid video-laparoscope

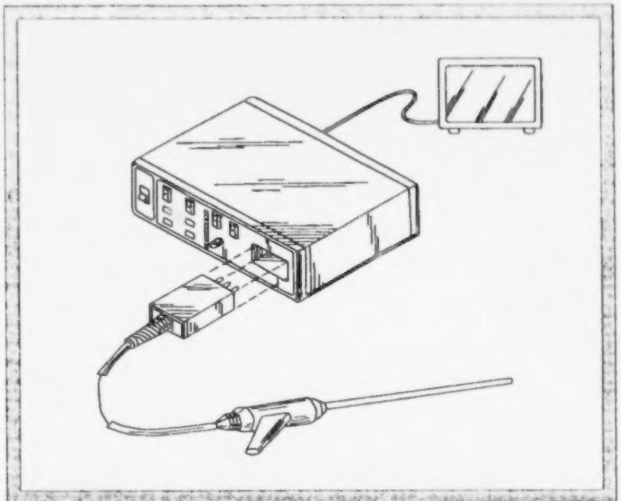


Figure 6
Video laparoscope

- Flexible scopes
  - Ultrasonic endoscope

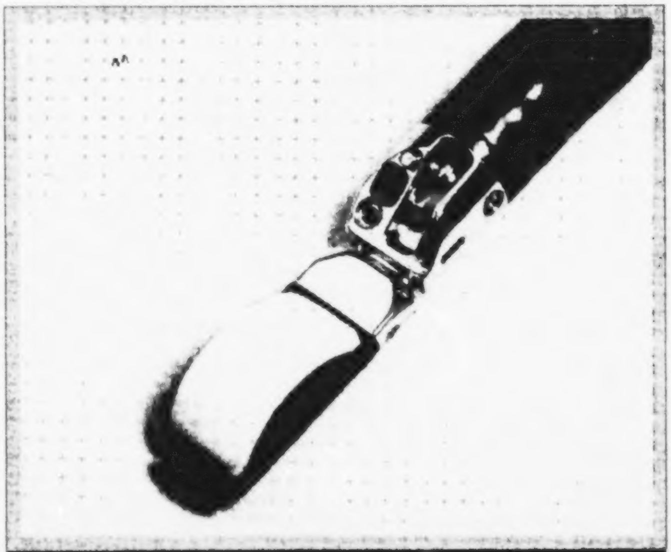


Figure 7
Ultrasound endoscope

Photo of Pentax FG-36UX Courtesy of Pentax Precision Instrument Corporation.

1488

- Fiber-endoscope (fiberscope)
- Endo-periscope
- Flexible video-endoscope

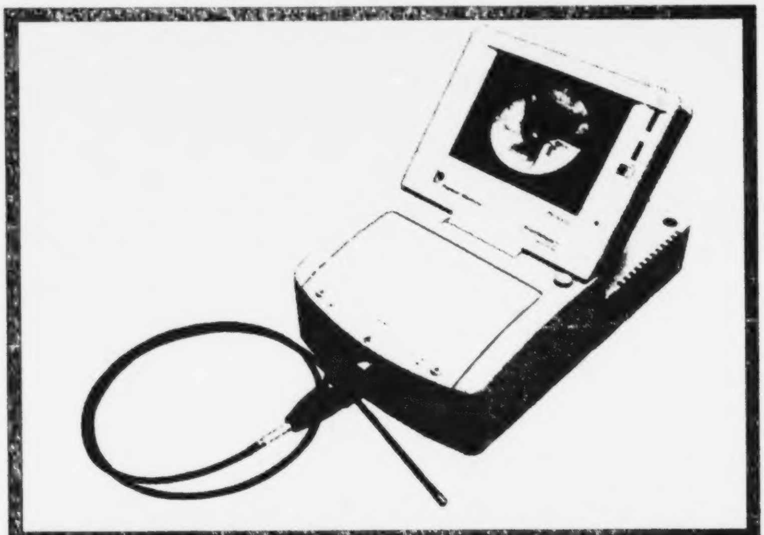


Figure 8
TrachView Intubating Videoscope

Courtesy of Parker Medical, Inc.

## Student Supplement 4—System Components

### BASIC COMPONENT GROUPS

Robotic systems vary greatly in complexity of design, based on the task(s) they are to perform. Some require very few **degrees of freedom** to perform, while others have as many basic degrees of freedom humans do. In the medical field, most robotic systems emulate in some fashion the human arm. For this reason, they are generally serial robots with **articulated arms** and are comprised of four basic subsystems:

- Articulated Mechanical System (AMS)
- Controller
- User interface
- External power

KEY TERMS

**Degree(s) of Freedom (DOF)**—Independent directions of motion; angle of movement; position and orientation of mechanism. For translational movement, it is a linear coordinate on a single plane or direction. For rotational movement, it is an angular coordinate about a fixed axis.

**Articulated arm**—Comprised of joints and links that allow for maximum degrees of freedom within reachable space of the robot.

**End-effector**—The mechanism that either retains the specific tool to perform the robotic task or the means to grasp, hold or lift the intended object. Multiple DOF can be used here, depending on the tool installed at its tip. Frequently, the purpose of the end-effector is to grasp through an open/closed motion.

### ARTICULATED MECHANICAL SYSTEM (AMS)

- Mechanical arm or manipulator
  - Base (Waist)
  - Arm (Shoulder, Elbow, Wrist)—Serves to position and orient the tool
    - Joints—Segments of the robotic arm
    - Links—Sections between the joints where the pivot point is located and where the engine drives robotic motion
    - Drive—The engine that moves the links, which move the joints, which position the end-effector
  - End-effector (Hand)—Retains the tool and actually performs the task
    - Sensors—Send signals to the controller to notify the system of its location and the state of its surroundings. Sensors can detect things human senses cannot, such as radiation or movement indiscernible to humans.
  - Actuators—Act on the signals sent by the controller

- Transmission system that moves the mechanical arm
- System interface to controller

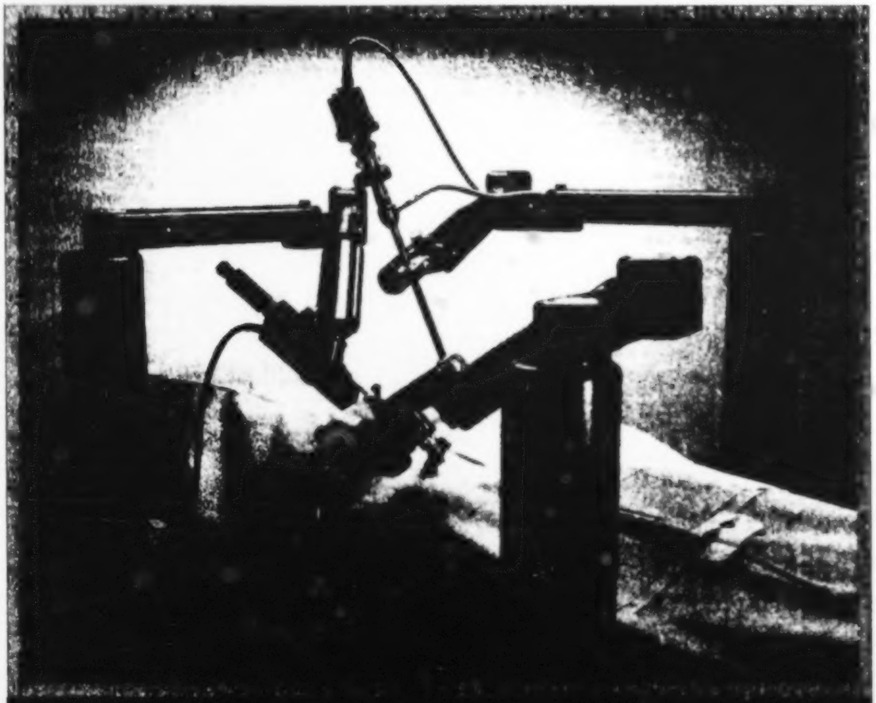


Figure 1
Example of robotic arms, Zeus

Courtesy of Computer Motion, Inc.

### CONTROLLER

The most complex and least visible component of the robotic system. Comprised of two parts: robotic controllers and system controllers. The computer functions as the "brain" of the robot and is also capable of interfacing with other machines and other systems. The computer is run by a set of machine code instructions within a program and can be pre-programmed, taught, or function autonomously (artificial intelligence).

- Robotic controller—Manages the physical aspects of the AMS
- System controller—Manages commands from the software program

### USER INTERFACE

Multifunctional robotic systems frequently provide an autonomous console from which the surgeon directs robotic movements. In these instances, the console may be outside of the sterile field. Some systems, such as da Vinci, have distance limitations of fifteen feet from the operating table.

- User interface
  - Monitor

  - Mouse or joystick or pad
  - Keyboard
  - Any output devices
- Software program

**Figure 2**
**Example of telesurgical observation and remote input**

Courtesy of Computer Motion, Inc.

**External power**

Because of the risks associated with power failure, robotic systems require not only a robust power supply, but an uninterruptible power supply (UPS), as well.

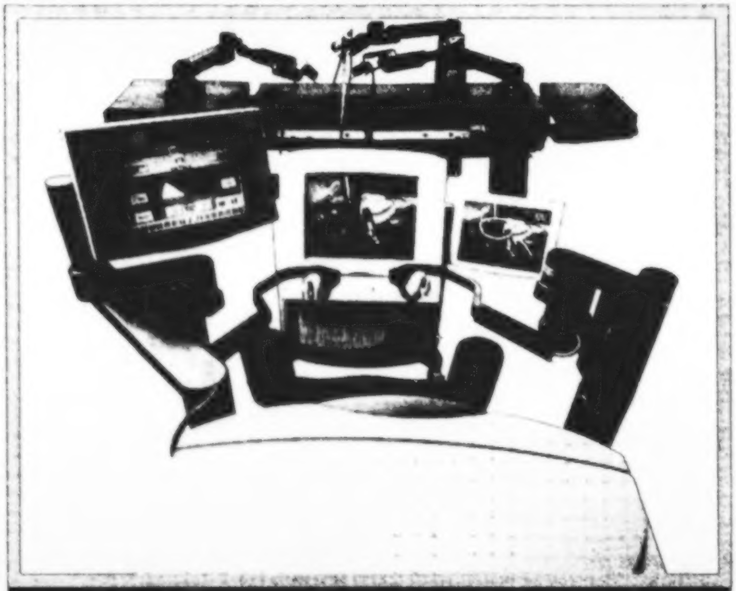


Figure 3
Example of entire robotic system, Computer Motion, Inc.

Courtesy of Computer Motion, Inc.

## Student Supplement 5—Robotic Motion

### Degrees of Freedom

As mentioned earlier, the complexity of surgical robots varies, depending on the task it is designed to complete. Some of the more basic endoscopic assistants used for camera control function on three degrees of freedom. Most of the autonomous robots designed to assist in or perform surgery require six degrees of freedom.

### Purpose of Motion

- To position
- To orient
- To manipulate

Key Term

**Axis**–A line that passes through the center of the mechanism about which a moving part can turn, extend, flex or rotate.

### Joint Types

- **Prismatic joint (P)**—Operates on a single linear coordinate or translational DOF on the X-, Y- or Z-axis

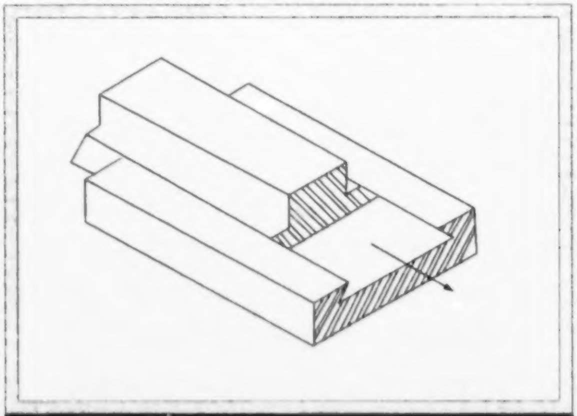


**Figure 1**
**Prismatic joint**

From *Fundamentals of Robotic Mechanical Systems* by Jorge Angeles, page 107, Figure 4.1, ©Springer-Verlag, 2002.

- **Revolute joint (R)**—Operates on a single rotational DOF that revolves around a fixed point on the X-, Y- or Z-axis

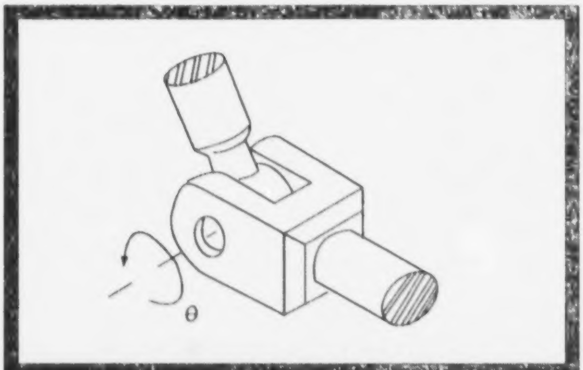


Figure 2
Revolute joint

From *Fundamentals of Robotic Mechanical Systems* by Jorge Angeles, page 107, Figure 4.1, ©Springer-Verlag, 2002.

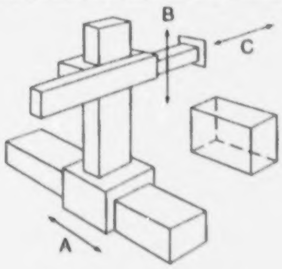
- **Spherical joint (S)**—Operates on three rotational DOFs

TYPES OF MOTION

- **Translational motion**—Translational movement can be on a single plane (separate axis control) or occur on multiple planes at the same time (coordinate axis control). Any linear or prismatic movement can be computed by moving on the following axes.
  - X axis—Moving horizontally left to right
  - Y axis—Moving vertically up and down
  - Z axis—Moving in and out
- **Rotational motion**—Revolute movement functions around a fixed point. Up to 360° rotation on any translational axis.
- **Wrist motion**
  - Yaw—Prismatic and revolute movement on the X-axis
  - Pitch—Prismatic and revolute movement on the Y-axis
  - Roll—Revolute movement on the Z-axis
- **End effector motion**
  - Grip—Moving open or closed

## BASIC ROBOT ARM GEOMETRY

- **Rectangular or Cartesian**—X, Y and Z prismatic or linear moves only (PPP)



Rectangular geometry
(Cartesian coordinates)
3P

Figure 3
Rectangular

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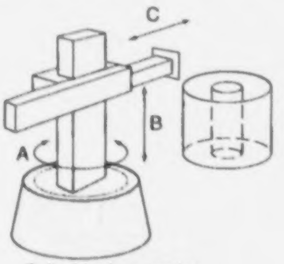
- **Cylindrical**—Y and Z prismatic motion and revolute motion on Y (RPP)



Cylindrical geometry
(cylindrical coordinates)
R2P

Figure 4
Cylindrical

Illustration reprinted with permission of TPC Training Systems—Buffalo Grove, IL 60089

- **Spherical**—X prismatic and X and Y revolute movements (PRR)

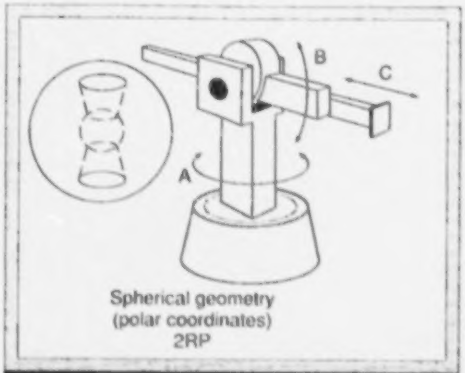

B
C
A
Spherical geometry
(polar coordinates)
2RP

Figure 5
Spherical

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- **Jointed or articulated**—Revolute movements on X, Y and Z (RRR)

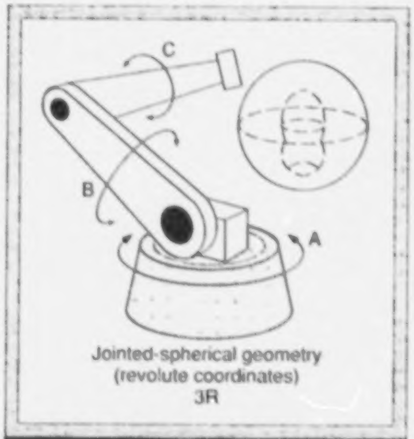
C
B
A
Jointed-spherical geometry
(revolute coordinates)
3R

Figure 6
Jointed

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## Student Supplement 6—Robotic Control

**CONTROL CORE AREAS**

Robotic control resides in three core areas:

- The control center run by the surgeon
- The physical sensors and actuators that are active during robotic tasks
- The computer programming that receives feedback from those sensors and executes pre-planned and real-time activities

**PROGRAMMING CONTROL**

Programming relies on instructional code that is designed so a machine can make use of it. Most often, this is not done in isolation. Tracking surgical instruments relative to the patient, the instrument and the surrounding tissue requires pre-registered marks and a program designed to interpret that data. Surgical robotics generally require very detailed frames of reference and are built with an open loop program, rather than closed loop, which is better utilized with inanimate objects. In all cases, programming must allow for manual intervention by the surgeon.

- Frames of reference
  - Specifies coordinates for movements (vector calculation)
  - Establishes computational relations between landmarks
  - Creates representations of space
- Program
  - Provides instruction codes
  - Allows manual override for "training" robot to perform specific task
  - Open loop
    - Establishes fixed or adjustable hard stops
    - Sets limit switches
    - Uses stepper motors
    - Utilizes programmable controllers
  - Closed loop
    - Allows for point-to-point path
    - Allows for continuous controlled path, as well

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### USER CONTROL

Surgical robotics must allow for surgeon intervention and direction. This direction can come in a number of forms, some of which are listed below.

- Vision systems—Often track eyeball movements of the surgeon and use these to reposition equipment. A robot's ability to see in dim lighting is known as its "sensitivity."
- Tactile systems—Track hand and arm movements through a haptic interface or joystick, smart mouse or keyboard. Some systems can be operated by hand or foot pedals, as well. Studies have shown that if robotic arms are used, this can be effective. For use with endoscopic positioning, it proves to be awkward, since it requires either the surgeon or an assistant to move the arm.
- Speech recognition systems—Recognize voice commands. Seem to be quite effective in positioning endoscopic arms. Some units require pre-programming to recognize the surgeon's voice. Others will recognize directional commands without surgeon-specific voice cards, allowing for more surgical flexibility, but also a slightly larger margin for error.
    - The robots are equipped with binaural hearing just as humans are. The sound transducers allow the robots to deduce the direction of sound.
    - Machine hearing is the terminology used to describe how robots "hear" and amplify sound.

### MECHANICAL CONTROL

Mechanical control of robotics requires that the robot be able to perform tasks based on machine-level commands and have an awareness of its surroundings. As it is performing its task, additional information about impact on tissue or structures is imperative. This information is relayed to computer software by sensors and external systems. Listed below are some of the primary means of creating robotic motion and receiving task status information.

- Motion control
- Actuators
- Sensor control

# Student Supplement 7—Robotics in the Operating Suite

**Robotic Surgery**

The integration of robotics in the medical field has been much slower than that of industry in general. This is for a variety of reasons, most of which are cost or safety or design related. Those robots that have been readily integrated so far are those that image or model human structures or provide visual (endoscopic) support. Industry has certainly proved that reliability, speed and repetitious precision are key benefits in using robotics. Medicine requires further aseptic and safety standards. Further, the greatest use for robotic surgery may lie in performing tasks that are too minute or too inaccessible for humans.

**Robotic Acceptance**

While there are many in the medical field that resist the use of any automation in the surgical suite, there are some who are anxious to integrate new surgical tools as they become available. An example of this would be two German surgeons using RoboDoc to assist in milling hip bones to precisely fit the hip prosthetics. Both had performed thousands of manual surgeries and neither had ever used a robot. Even though one surgeon was quite skeptical, patient results have been extremely positive, winning him over. The precision and successful healing around the implant has allowed for rapid recovery (30% shorter hospitalization) and full weight bearing within a day or two. In contrast, manually drilled hip bones had a much higher incidence of being more than 30% oversized, which leaves significant gaps around the implant, slows healing and impacts weight bearing.

For others, it is not the technology that is an issue, but the cost. Since there are still very few players in the medical robotics field, prices are high. Many companies have opted to break their product lines into modular sections, not only for versatility, but also for price point. Each multifunctional robot is comprised of at least two products: the endoscope and the robotic arms. Additionally, most bill the control software, as well as the visioning system, as autonomous entities.

**Draping and Aseptics**

The most commonly used robotics systems in the United States have custom draping systems. The companies that design and manufacture them have specific training materials that are provided with the purchase of a robotics unit. Since this is the case, specific draping procedures can be reviewed either online or by videotape. As a general rule, draping is performed after the patient is on the OR table and the robotic arm(s) are positioned properly for the specific procedure. Drapes are then applied using aseptic technique to the arm and to the hand control. Additional drapes may be required, depending on the robotic mechanism and its docking station. Once in place, the drapes are cinched to remove excess. Then, sterile collars and instruments may be inserted, replaced and/or removed at the appropriate time. The sterile collar, instruments, and endoscope are decontaminated and sterilized prior to use.

**The Future**

Some surgeries have already been performed across the Atlantic Ocean, with the surgeon on one side and the patient on the other. The surgeon's remote presence allows for a specialist to preside over a remote surgery performed by another surgeon. It opens the door to mentoring and training in new and different ways. This same technology also provides for new opportunities in simulation and training through virtual reality, where the "surgery" only occurs within the frame of the computer. This allows for a review of surgical technique, etc. and allows for tracking and review of the surgeon's success.

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**OBJECTIVE 44**

# Assignment Sheet 1—Evaluate MIS Procedures

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, spelling, and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

**INTRODUCTION**

Surgical robotics systems are being utilized in the greater arena of minimally invasive surgery, which has changed dramatically from its inception in the 1970's. Proper identification of minimally invasive procedures and those tools used to perform such procedures will prepare the surgical technologist with a foundation for understanding robotics in that environment.

**DIRECTIONS**

Respond to each question or situation, then have your instructor evaluate.

1. Describe the trend towards minimally invasive surgery and apply it to your experiences in the health industry.

2. Which of the drawbacks to MIS do you consider to be the strongest rationale for conducting open surgery? Give an example.

3. You are scheduled to assist in a hernia repair. There has been a heated debate about whether to use the brand-new robotics equipment, perform the same operation laparoscopically, or to revert to a standard open procedure. Describe the benefits and drawbacks to each approach. List differences in the following areas:

Efficiency and ease of use

Time in surgery

Recovery time

Expense

Introduction to Surgical Technology
Section E: Biomedical Science
Module 4-E: Robotics

**Objective 45**

## Assignment Sheet 2—Compare Surgical Robotic Equipment

Name ______________________________ Date ______________

| Evaluation criteria | Rating |
|---|---|
| • Directions were followed | ______ |
| • Questions were answered honestly | ______ |
| • Correct grammar, spelling, and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ________________________________________

________________________________________________________

________________________________________________________

**Introduction**

Cardiac surgery, neurosurgery, optical surgery and orthopedic surgeries are the first benefactors when medical robotics systems are integrated into operational procedures. This overview of various product lines and the niches they fill should provide you with a greater confidence when exposed to robotics in the OR.

**Directions**

Research the robotic surgical equipment companies listed in Part I and classify them into robotic types, based on Objective 19 definitions. Each product may fall into more than one category. Then, choose two of the situations listed in Part II and respond to those situations.

**Part I**

Visit the following Web sites to review their robotic surgical equipment:

http://www.armstrong-healthcare.com/endoassist.htm
http://www.robodoc.com/eng/neuromate.html
http://www.robodoc.com/eng/robodoc.html
http://www.computermotion.com/zeus.html
http://www.intuitivesurgical.com/products/da_vinci.html
http://www.sri.com/ipet/ts.html
http://www.mdx.ac.uk/www/ammc/apd/apd.html (non-surgical: used for example only)
http://www.urs-group.com/ go to ortho for Caspar
http://www.iai.fzk.de/medtech/medrob/artemis/welcome_engl.html

1. Computer-aided supervisory robots or dexterity-enhancing robotics

2. Image-guided robotics

3. Tele-operative robotics

4. Autonomous robotics

**PART II** Respond to two of the following situations.

SITUATION 1 Compare the surgical procedure for removing a brain tumor with a robotic arm used for camera positioning vs. a multifunctional unit, replete with camera and two additional articulated arms.

SITUATION 2 The 58-year old CEO of a leading Fortune 500 company in town has been brought to the hospital. The doctors are considering a MIDCAB (Minimally Invasive Direct Coronary Artery Bypass), but the newest cardiac surgeon has recommended they explore Totally Endoscopic Coronary Artery Bypass (TECAB) as an alternative. In this case, there is no need for the heart and lung machine, and the operation is conducted on the beating heart. Surgery would take longer, but recovery time would be under a week. The CEO needs to be back on her feet within a week. Our surgeon has had multiple experiences with robotics and is confident it is a fit. List the possible robotic candidates for performing this surgery. Recommend one and explain your rationale.

SITUATION 3

You are training a coworker to assist one of the top hip replacement surgeons on staff to use RoboDoc on a 62-year old woman. You have been explaining patient prep and are going to demonstrate registration. Describe your options and how you will go about it.

**OBJECTIVE 46**

## Assignment Sheet 3—Identify Robotic Components

Name ______________________________ Date ______________

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Diagram of robotic arm was drawn and labeled correctly | ______ |
| • Correct grammar, spelling and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________

______________________________________________

______________________________________________

**INTRODUCTION** Proper identification of primary robotics components is the first step to assisting, using or troubleshooting the robotics system. While most of this is simple rote memorization, it is a worthwhile exercise to ensure foundational knowledge prior to actually exploring its clinical application.

**DIRECTIONS** Respond to each of the following parts of this assignment sheet.

**PART I** Diagram and label the five major components of a robotic arm.

**PART II** There is a functional error on robot arm 2 that indicates proximity sensor failure. Recommend a course of action to remedy the situation and explain your reasoning. Describe an alternative course of action and explain your rationale for placing it second in priority.

**PART III** Describe the difference between when a robot moves to a specified position and when a robot is oriented to perform a task, including the mechanism(s) by which this is accomplished.

**OBJECTIVE 47**

## Assignment Sheet 4—Identify Robotic Motion

Name ______________________________ Date ______________

**Evaluation criteria** **Rating**

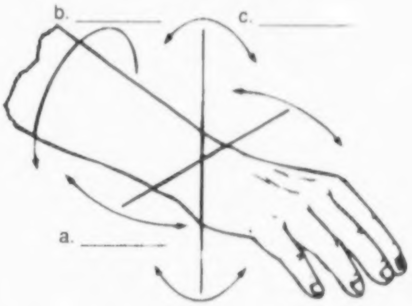
- Directions were followed ______
- Motions were correctly identified ______

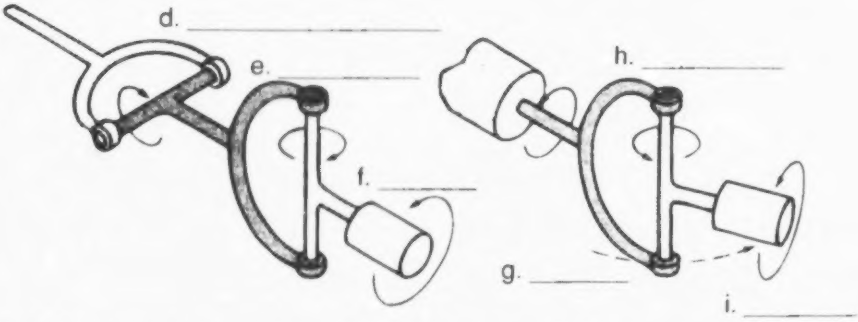
**Overall rating** ______

Evaluator's comments ______________________________

**INTRODUCTION** Robotic motion occurs on three axes and robotic control manages that motion.

**DIRECTIONS** Identify each type of motion in the following illustrations.





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**OBJECTIVE 48**

## Assignment Sheet 5—Explore Clinical Applications for Robotics

Name ______________________ Date ____________

---

| **Evaluation criteria** | **Rating** |
|---|---|
| • Directions were followed | ______ |
| • Situations were responded to honestly | ______ |
| • Correct grammar, spelling, and punctuation were used | ______ |
| **Overall rating** | ______ |

Evaluator's comments ______________________________________________

---

**DIRECTIONS** Respond to the following situations.

Situation 1 During a neurosurgery, one of the robotic instruments has ceased functioning. The error message indicates a short in the tool. Determine whether it is best to replace it with another instrument or revert to manual neuroscopic surgery.

SITUATION 2

Your cousin has contracted a rare form of intracranial brain tumor. You know from your experiences in the OR that a classical craniotomy for biopsy and resection requires large skin flaps and large openings in the skull bone. The doctors have performed MRI and CT scans and have constructed a 3-D image of your cousin's brain. They are considering robotic intervention in lieu of a classical craniotomy. You have reviewed the stereotactic frame that allows a Cartesian robotic system to hold the patient's head and calculate the surgical trajectory. You've even researched the newer frameless robotic systems that can calculate the trajectory without holding the patient's head in a frame. Your cousin is nervous about considering having robotics involved. Explain to your cousin how a Cartesian robot moves and try to convince your cousin to go with robotics through your explanation. When your cousin is still emphatically opposed to the process, switch positions and explain some of the drawbacks.

**OBJECTIVE 49**

# Job Sheet 1—Demonstrate Degrees of Freedom in the Human Arm

Name ______________________ Date ______________________

Attempt number ______________________

---

**Evaluation criteria** **Rating**

- Directions were followed ______
- Demonstration of experiment was successful ______

**Overall rating** ______

Evaluator's comments ______________________________________

---

**INSTRUCTIONS** Use the following method to demonstrate each degree of freedom of your arm.

**PROCEDURE**

☐ 1. Point your right hand directly to the right side from the shoulder, holding the arm stiff.

☐ 2. From the shoulder only, move the arm up and down. This is the first degree of freedom and is called *pitch*.

☐ 3. Return your arm to its original position in Step 1.

☐ 4. Move your arm from side to side. This is the second degree of freedom and is called *yaw*.

☐ 5. Return your arm to its original position in Step 1.

☐ 6. From the shoulder only, move the arm around in a circle. This is the third degree of freedom and is called *roll*.

☐ 7. Hold your right arm at your side and extend it out to the right side from the elbow so that your lower arm is perpendicular to your body.

☐ 8. From the elbow only, move the arm up and down. This is the fourth degree of freedom. This should be familiar by now; it is pitch.

☐ 9. Point your right hand directly to the right side from the shoulder, holding the arm stiff.

☐ 10. From the wrist only, move the hand up and down. This is the fifth degree of freedom. Yep, you got it: pitch.

☐ 11. Return your arm to its original position in Step 1.

☐ 12. From the wrist only, move your hand from side to side. This is the sixth degree of freedom and, yes, this is yaw.

☐ 13. Return your arm to its original position in Step 1.

☐ 14. From the wrist only, roll the hand around in a circle. This is the final, seventh degree of freedom: roll.

Evaluator's Comments: ______________________________

______________________________

______________________________

Information in this job sheet was adapted from http://www.thetech.org/exhibits_events/online/robots/overview/

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